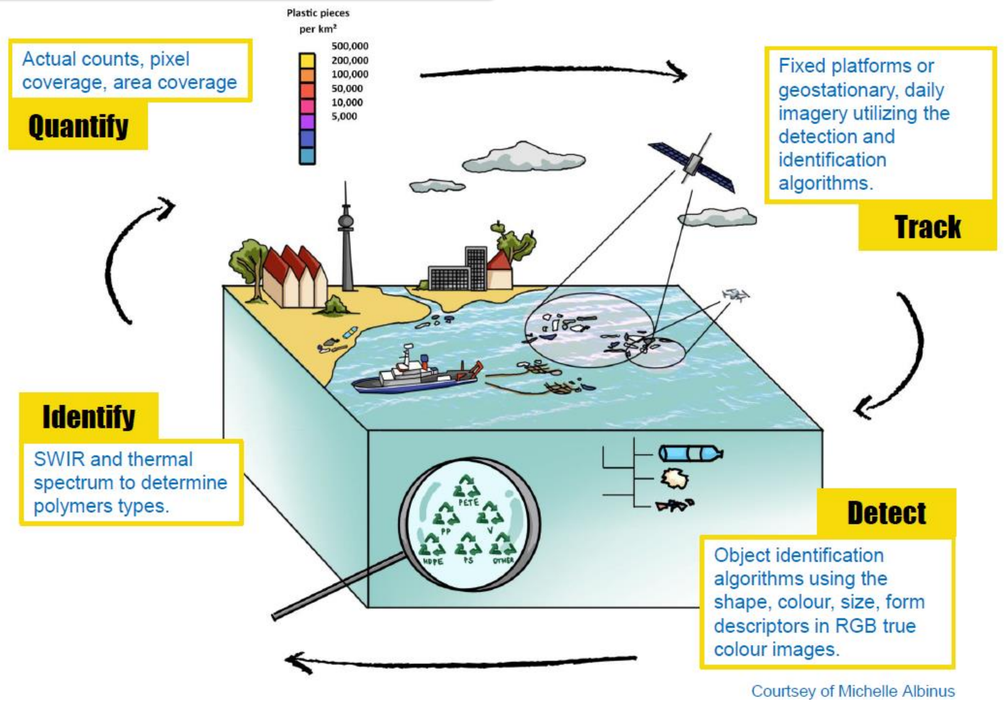
Multispectral detection and quantification of floating litter from fine pixel satellite data

Shungu Garaba * and Young-Je Park °
shungu.garaba@uol.de; youngjepark@kiost.ac.kr

*** Institute for Chemistry and Biology of the Marine Environment, University of Oldenburg, Germany**
° Korea Institute of Ocean Science and Technology, Republic of Korea

Overview of Research

We study the **detect**, **identify**, **quantify** and **track** capabilities of fine pixel multispectral satellites in the monitoring of riverine litter. Despite cloud cover constraints in observations, time series monitoring at sub-daily to several years was showcased. Knowledge about the surface area quantities, dynamics and hotspots locations can be leveraged to improve policymaking, targeted awareness or cleanup efforts initiated by citizen or local authorities. Using the derived statistics stakeholders can assess the efficacy of laws and cleaning efforts whilst thriving to improve water quality and the health state of the natural environment.



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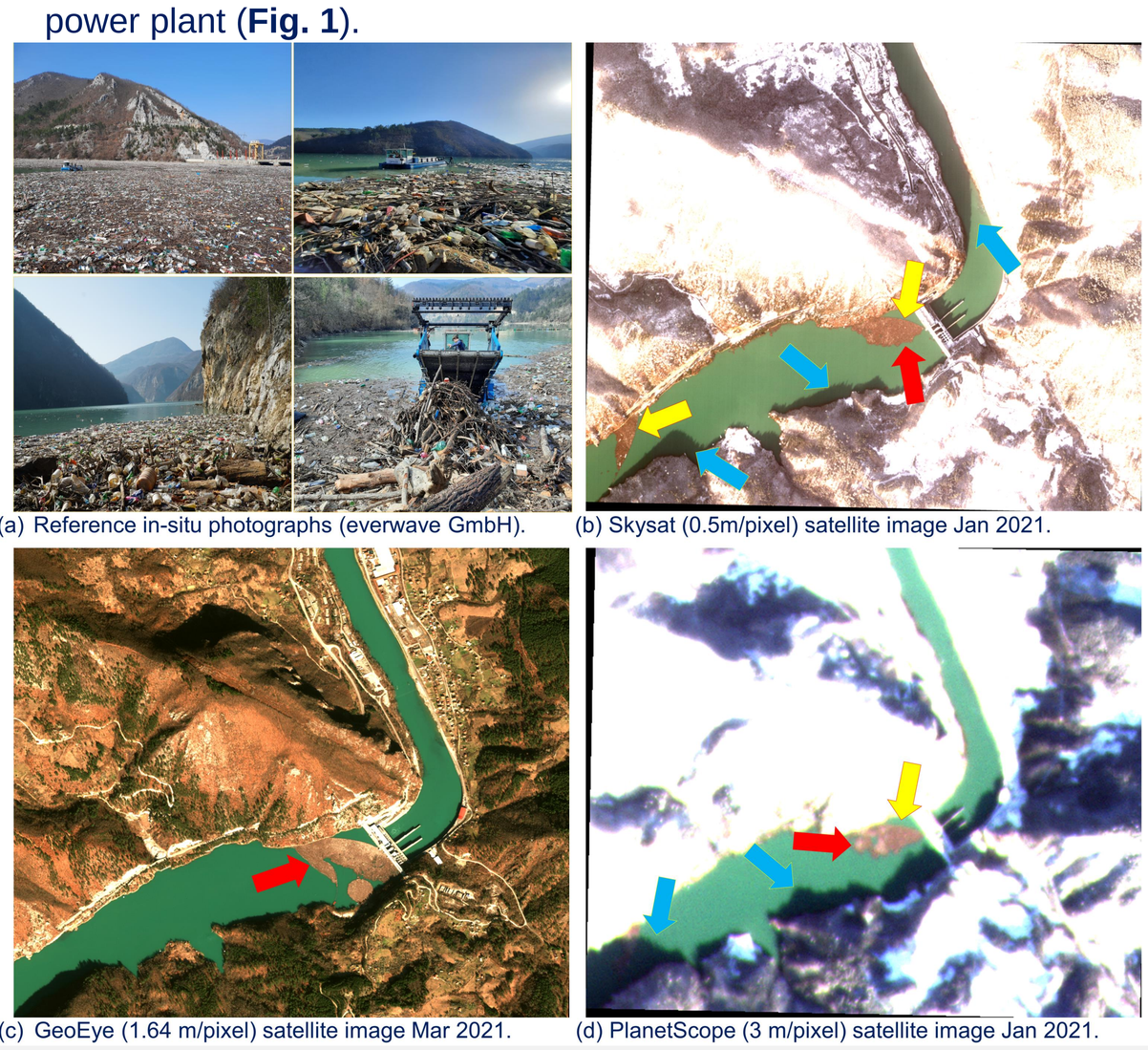
Methods and Materials

- Case study was completed on a region near Višegrad Hydroelectric power plant (**Fig. 1**).



(a) Reference in-situ photographs (everwave GmbH). (b) Skysat (0.5m/pixel) satellite image Jan 2021.

(c) GeoEye (1.64 m/pixel) satellite image Mar 2021. (d) PlanetScope (3 m/pixel) satellite image Jan 2021.

Fig. 1 Reference photographs and satellite imagery Višegrad Hydroelectric Power Plant.

- Photographs at the study site revealed riverine litter was a mixture of natural and anthropogenic items (**Fig. 1a**)
- Key features were floating litter (red), shadows on the water surface (blue) and floating litter holding as well as guiding booms (yellow).
- Radiance-to-reflectance conversion, Rayleigh correction, bright pixel masking, spatial variability test were applied to imagery to derive the fractional pixel abundance of litter (α).

$$R(\lambda) = (1-\alpha)R_w(\lambda) + \alpha R_L(\lambda) \qquad (1)$$

Debris-covered fractional area $\alpha = \frac{\Delta - \Delta_w}{\Delta_L - \Delta_w}$

$\Delta = R(\lambda_{NIR}) - R(\lambda_G)$ $\Delta_L = R_L(\lambda_{NIR}) - R_L(\lambda_G)$ $\Delta_w = R_w(\lambda_{NIR}) - R_w(\lambda_G)$

Findings and Outlook

- Analyses were based on spectral shapes and waveband differences.

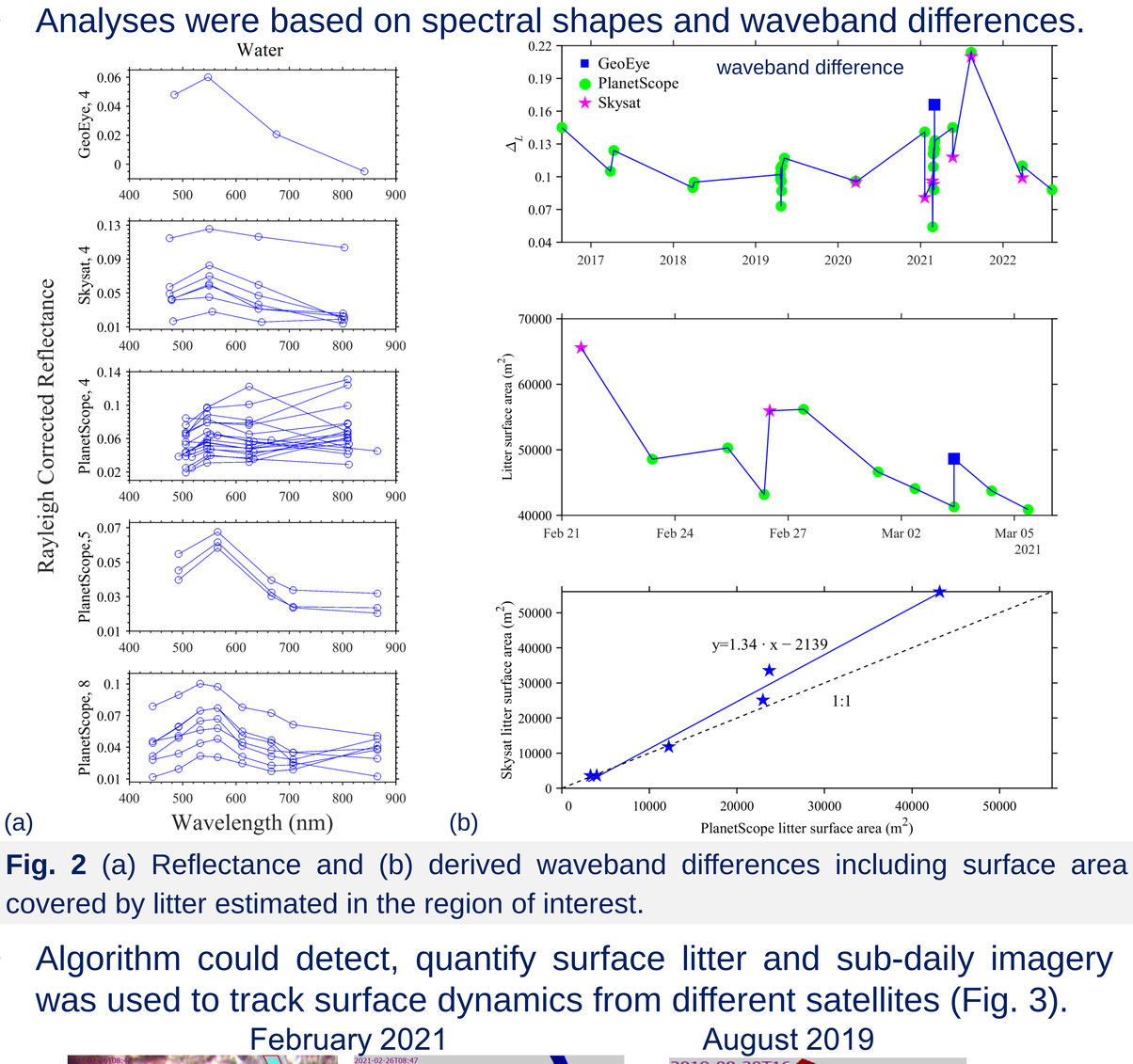


Fig. 2 (a) Reflectance and (b) derived waveband differences including surface area covered by litter estimated in the region of interest.

- Algorithm could detect, quantify surface litter and sub-daily imagery was used to track surface dynamics from different satellites (Fig. 3).

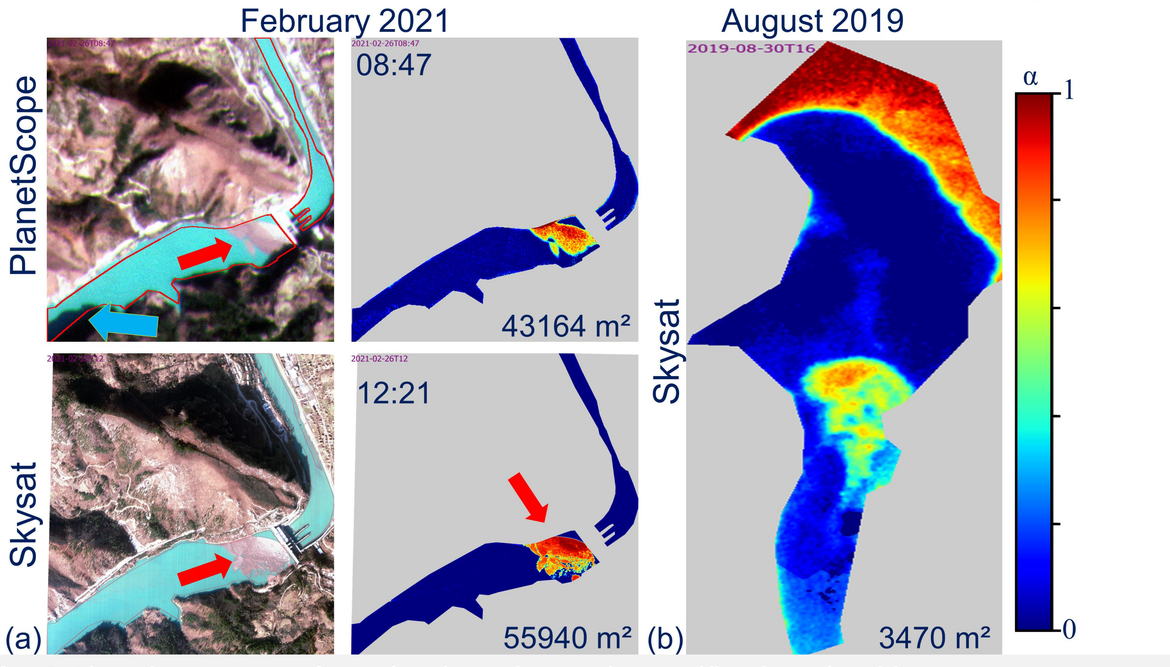


Fig. 3 Abundance maps from the detection and quantification algorithm.

- Algorithm transferability was demonstrated in Guatemala (**Fig. 3b**).

Acknowledgments

Satellite imagery was made available via the European Space Agency Third Party Mission under Proposal ID 62280 and 66473. We are grateful for the reference photographs and insights by Tilman Flöhr, Inga Hilbig (everwave GmbH, Germany) and Renata Correia (The Ocean Cleanup, The Netherlands). SG was supported by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) – Project No. 417276871 and the Discovery Element of the European Space Agency's Basic Activities contract no. 4000132037/20/NL/GLC. Y-JP acknowledges the support of the Ministry of Oceans and Fisheries for the research projects: 'Technology development for practical applications of multi-satellite data to maritime issues' (Project No. 20180456) and 'Development of marine satellite image analysis application technology' (Project No. 21210046).