<17 OCT 2022 COASTAL ZONES & OCEANS>

ID. 59193

PROJECT TITLE: INNOVATIVE USER-RELEVANT SATELLITE PRODUCTS FOR COASTAL & TRANSITIONAL WATERS

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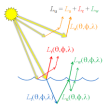
PRESENTED BY: EVANGELOS SPYRAKOS

Dragon 5 Mid-term Results Reporting - Objectives

Develop and validate innovative user-relevant water quality monitoring products for coastal and transitional waters based on EO data, in order to support and improve the water ecosystem services, sustainable management and security.

Atmospheric correction over coastal waters



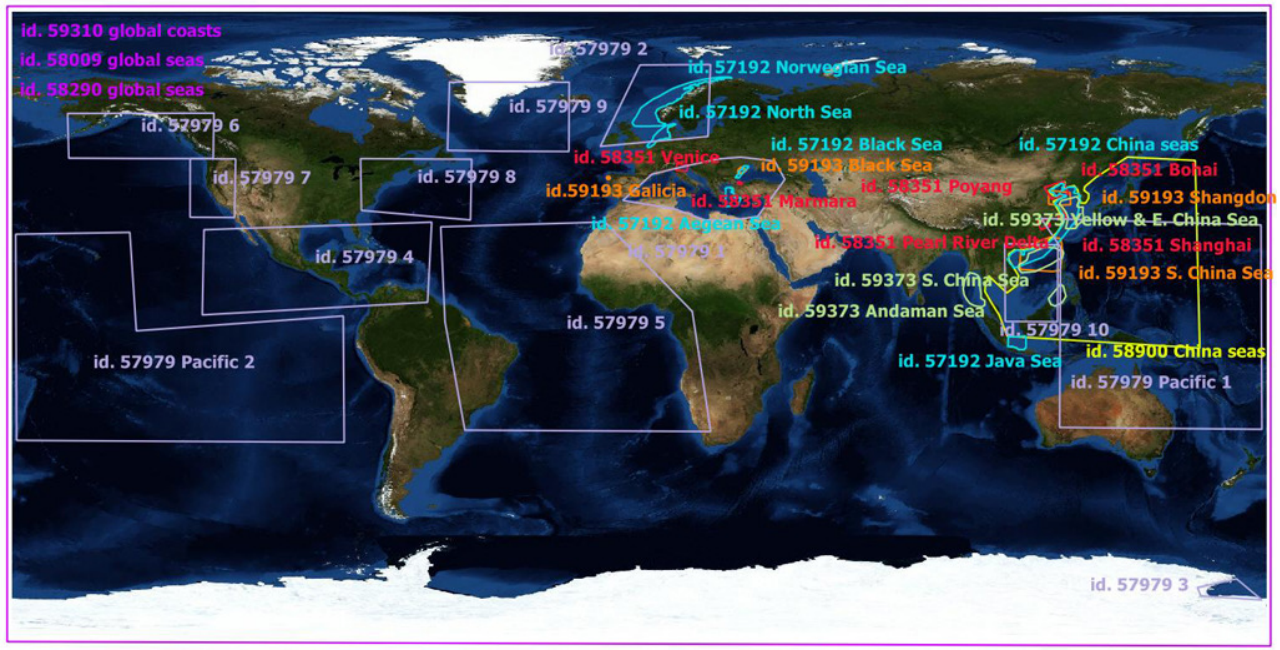
Phytoplankton size classes

Primary Production

Harmful algae

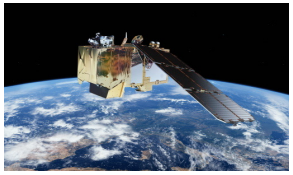
Marine oil spill detection and classification

Dragon 5 Mid-term Results Reporting - Sites

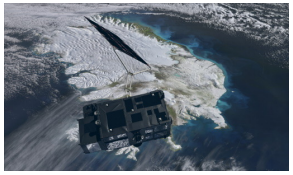


Danube Delta & Black Sea coast
Galician coast
Shandong Peninsula coast
Northern South China Sea

Dragon 5 Mid-term Results Reporting – Satellite data

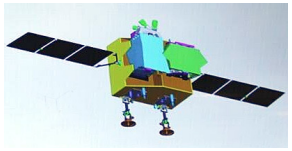


Sentinel-2

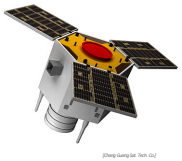


Sentinel-3

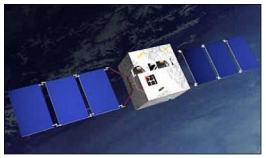
ESA, Explorers & Sentinels data



Gaofen-6

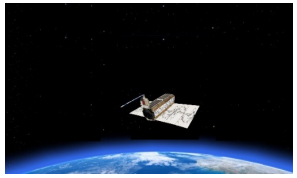


Jilin-1

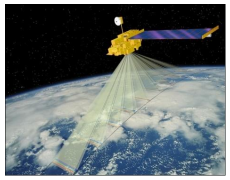


HY-1

Chinese EO data



PlanetScope



Terra

ESA Third Party Missions & ESA third party data

Images from: ESA, CAST, *Chang Guang Sat. Tech. Co.*

EO Data Delivery

Data access (list all missions and issues if any). NB. in the tables please insert cumulative figures (since July 2020) for no. of scenes of high bit rate data (e.g. S1 100 scenes). If data delivery is low bit rate by ftp, insert “ftp”

ESA Missions	No. Scenes
1. Sentinel-2 MSI	450
2. Sentinel-3 OLCI	1461
3.	
4.	
5.	
6.	
Total:	1911

Issues: No issues, sunglint affected scenes in coastal areas from May to September

ESA Third Party Missions	No. Scenes
1. Planet Super Doves	15
2. Landsat	>150
3.MODIS	>100
4.	
5.	
6.	
Total:	>265

Issues:

Chinese EO data	No. Scenes
1. HY-1C ultraviolet imager	8
2. GF-1 WFV	187
3.	
4.	
5.	
6.	
Total:	195

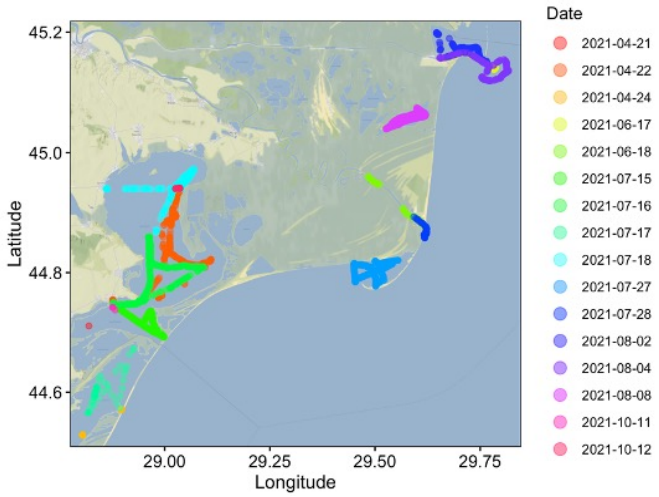
Issues:

Dragon 5 Mid-term Results Reporting – In-situ data needs

- AC assessment
- Radiative transfer modelling
- Development of retrieval algorithms
- Uncertainty characterisation

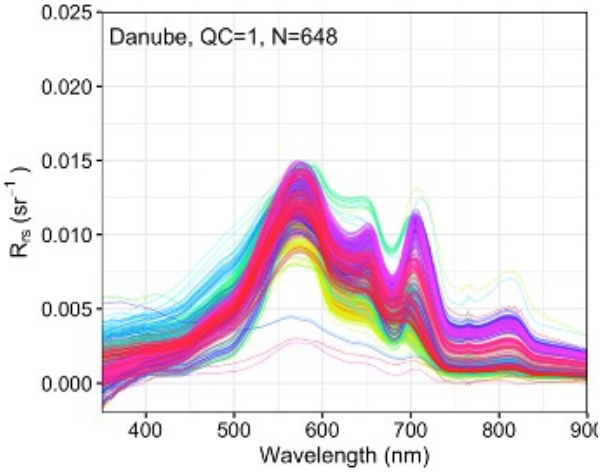
Dragon 5 Mid-term Results Reporting – In-situ data

Danube Delta campaigns
2021-2022
(130 stations)



Solar-Tracking Radiometry Platform (So-Rad) with TriOS Ramses sensors.

21/04/2021 – 22/05/2022:
9907 observations were obtained from **22** dates, excluding stationary observations.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 870349.

Dragon 5 Mid-term Results Reporting – In-situ data

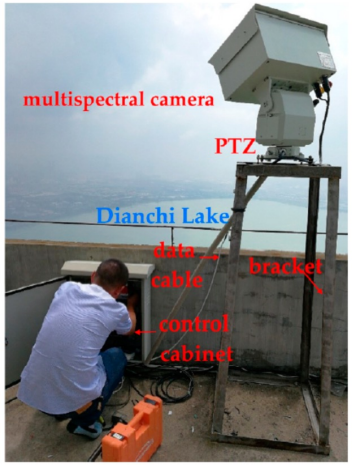
Yangtze River

lakes across Sri Lanka

Lake Taihu

Water Transparency work

Dianchi Lake



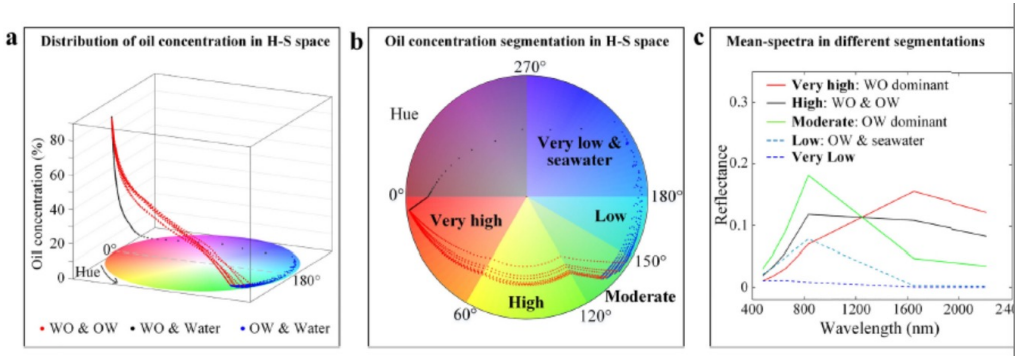
Cyanobacteria work

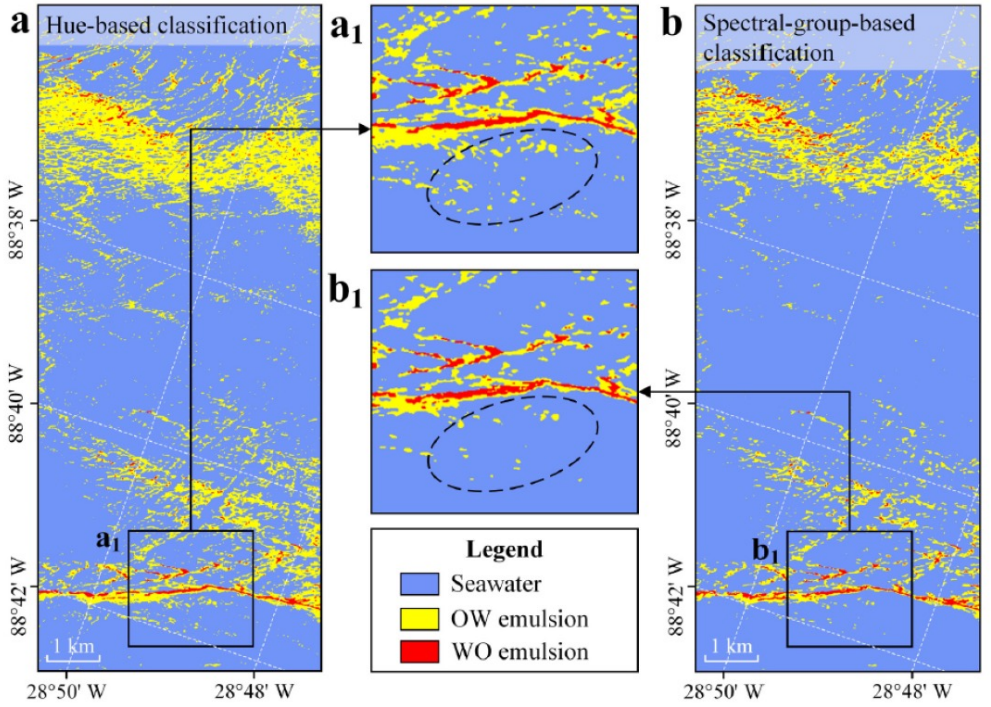
Aithrey loch

Assessing Planet reflectance values over water

I: Quantification of oil emulsions

A Hue-Saturation-Value (HSV) based oil emulsion classification and oil concentration segmentation methods were proposed and applied to Landsat-5 imagery.

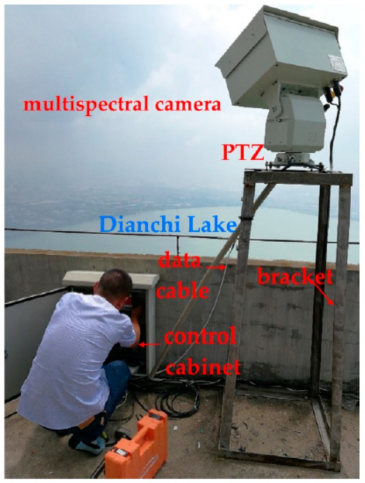


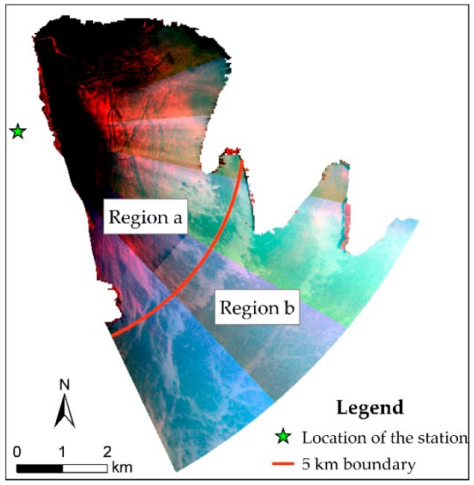


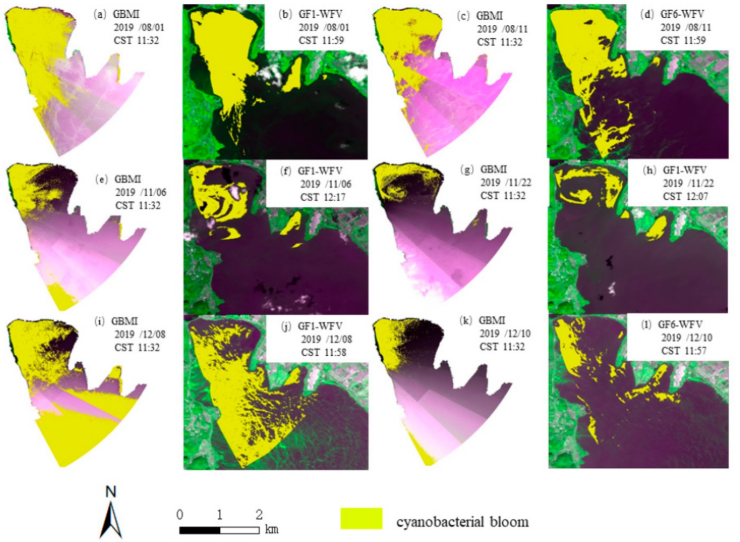
Junnan Jiao, Yingcheng Lu, Yongxue Liu. Optical quantification of oil emulsions in multi-band coarse-resolution imagery using a lab-derived HSV model. Marine Pollution Bulletin, 2022, 178: 113640

II: Monitoring of cyanobacteria blooms

Ground-based multispectral remote-sensing data can operationalize the dynamic monitoring of cyanobacterial blooms.



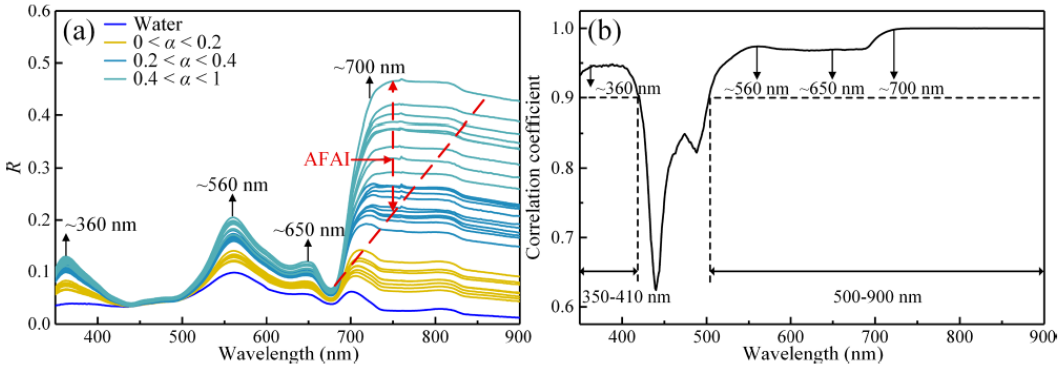


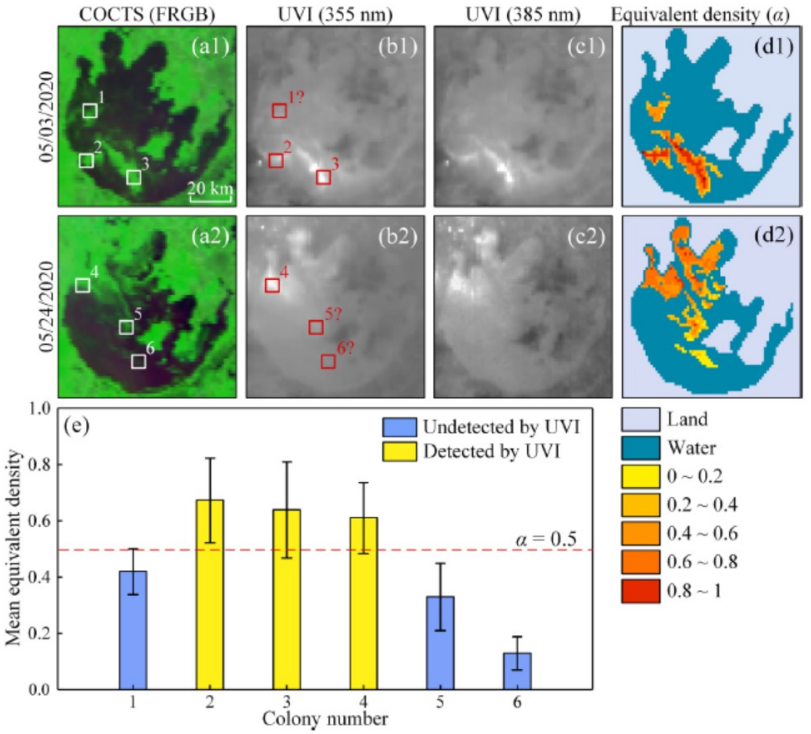


Huan Zhao, Junsheng Li, Xiang Yan, et al. Monitoring Cyanobacteria Bloom in Dianchi Lake Based on Ground-Based Multispectral Remote-Sensing Imaging: Preliminary Results. Remote Sensing, 2021, 13, 3970.

II: Monitoring of cyanobacteria blooms

Ultraviolet remote sensing, therefore, can work as a new approach for the detection of harmful algae blooms and help determine the floating status of them.

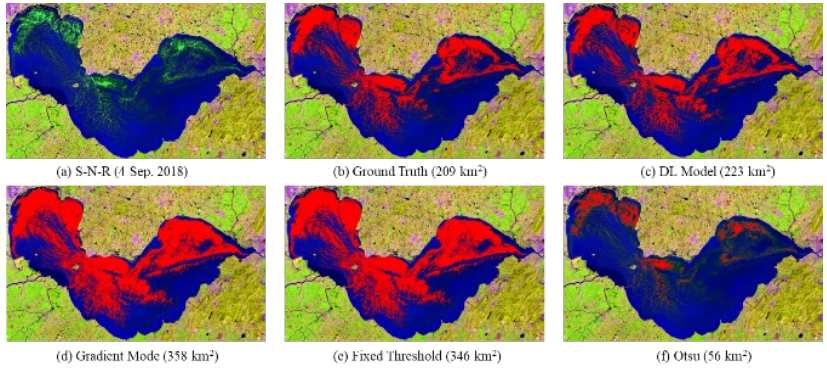


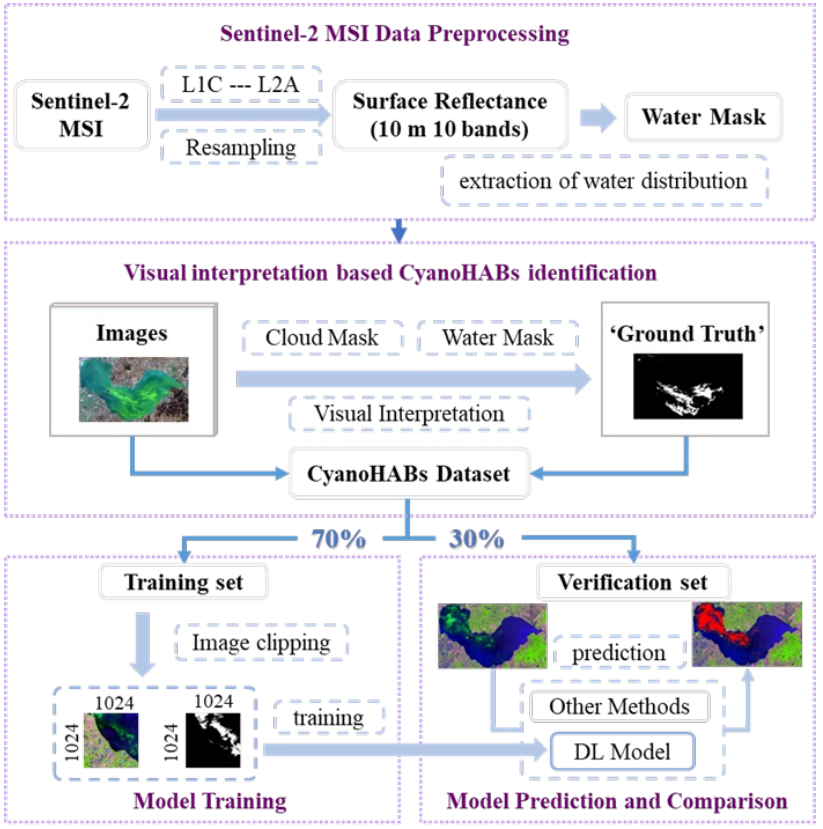


Ziyi Suo, Yingcheng Lu, Jianqiang Liu, et al. HY-1C ultraviolet imager captures algae blooms floating on water surface. Harmful Algae, 2022, 114: 102218

II: Monitoring of cyanobacteria blooms

A high-precision automatic extraction model for CyanoHABs using a deep learning (DL) network based on Sentinel-2 MSI data was developed.

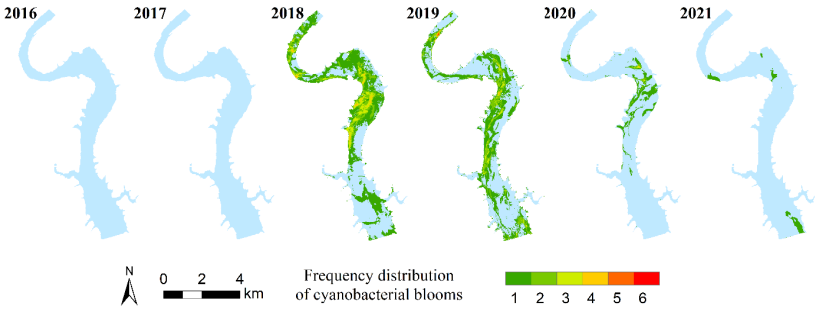


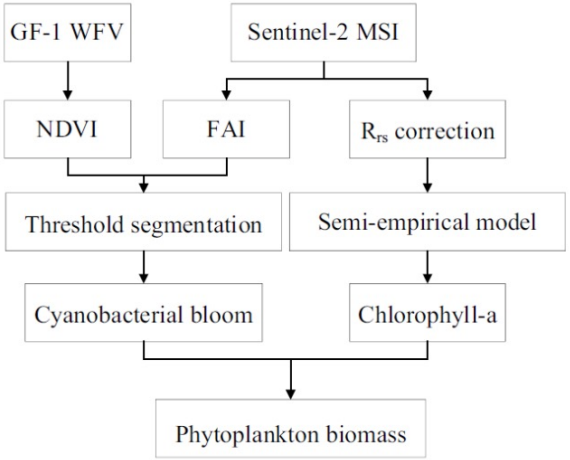


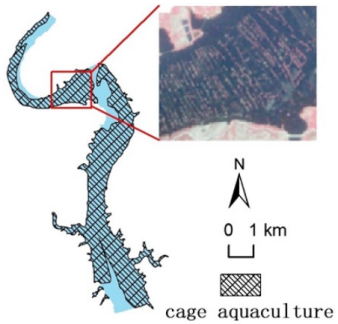
Kai Yan, Jusnehg Li, Huan Zhao, et al. Deep Learning-Based Automatic Extraction of Cyanobacterial Blooms from Sentinel-2 MSI Satellite Data. Remote Sensing, 2022, 14, 4763.

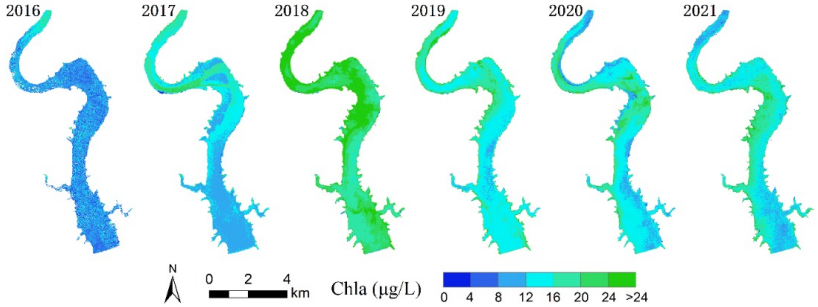
II: Monitoring of cyanobacteria blooms

Following the removal of cage aquaculture in 2017, phytoplankton biomass of the reservoir initially rapidly increased, and then declined.







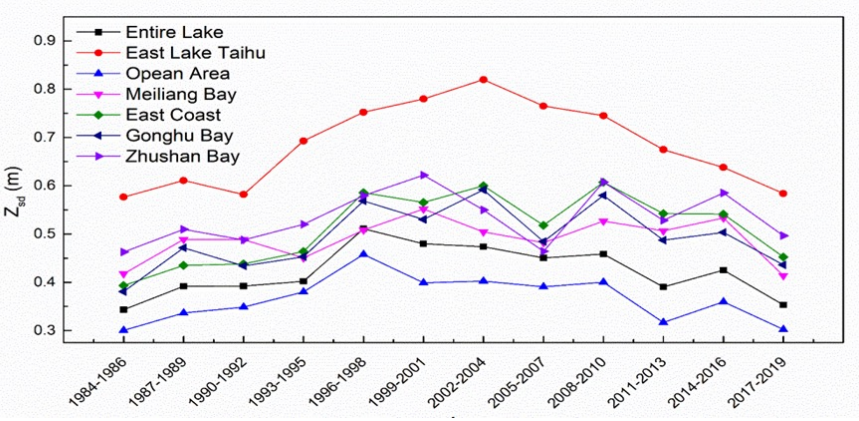


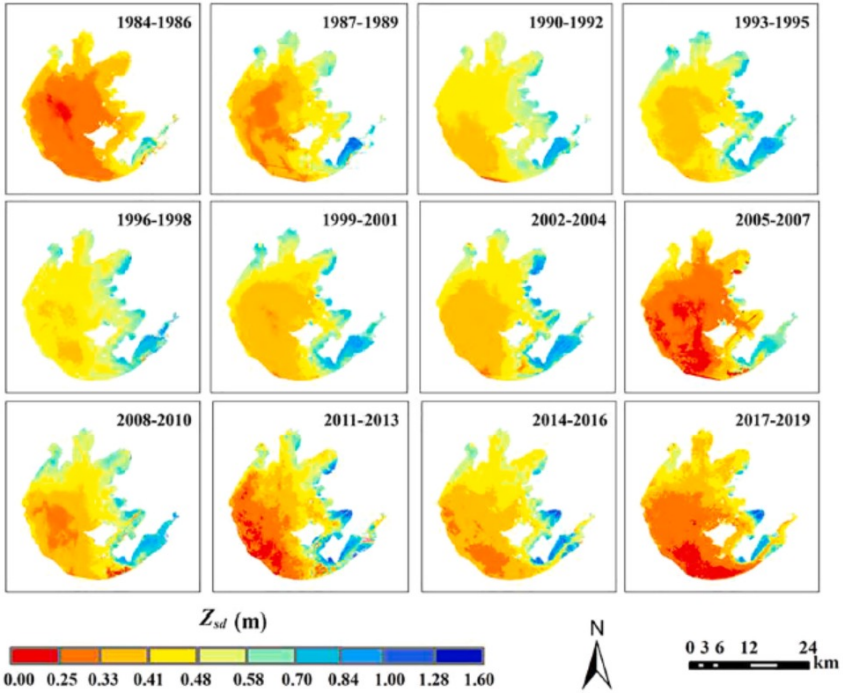
Ya Xie, Hongli Zhao, Junsheng Li, et al. Phytoplankton biomass variation after cage aquaculture removal from the Daheiting Reservoir, China: observations from satellite data. Hydrobiologia, 2022.

III: Assessment of water clarity variation

Water clarity variation in Lake Taihu from 1984 to 2019 based on Landsat series satellite data

The result shows an overall increasing trend from 1984 to 1998, and a decreasing trend from 1999 to 2019.



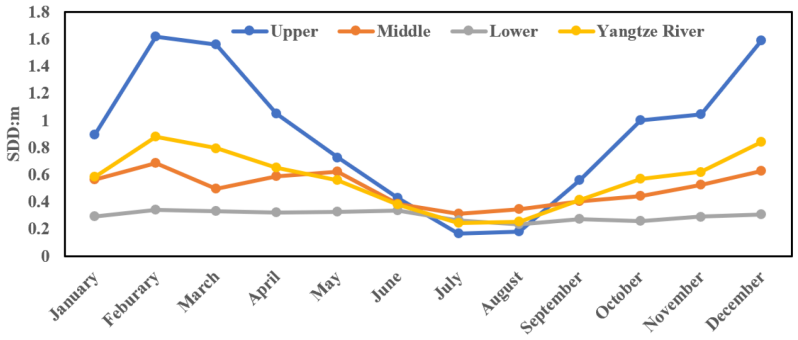


Ziyao Yin, Junsheng Li*, Yao Liu, et al. Water clarity changes in Lake Taihu over 36 years based on Landsat TM and OLI observations. International Journal of Applied Earth Observation and Geoinformation, 2021, 102: 102457.

III: Assessment of water clarity variation

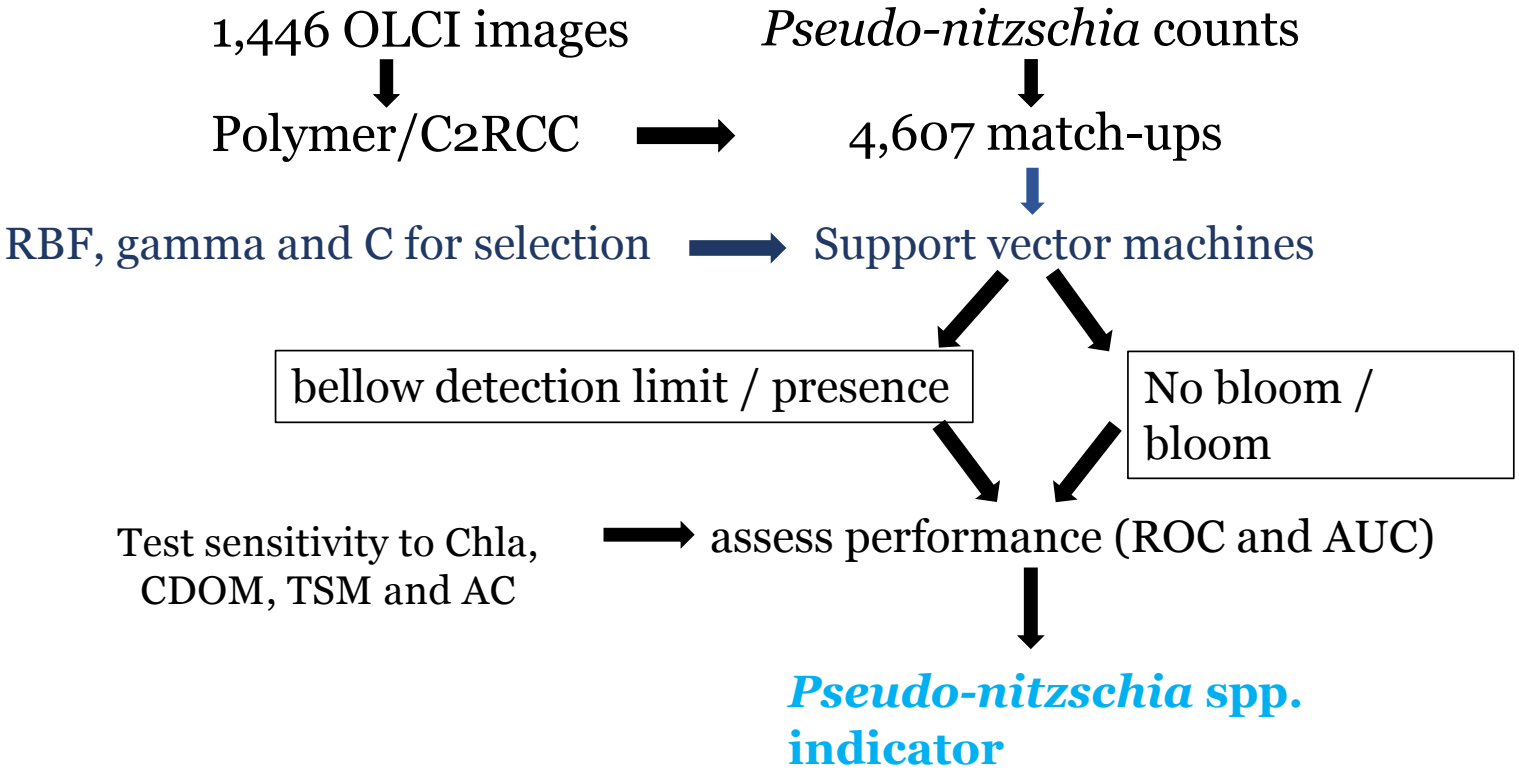
Water clarity variation in Yangtze River from 2017 to 2020 based on Sentinel-2 MSI data

The result shows:
(1) Spatial distribution: High in upper reaches, Low in lower reaches.
(2) Seasonally variation: High in winter, Low in summer.



Yelong Zhao, Shenglei Wang, Fangfang Zhang, Qian Shen, Junsheng Li. Retrieval and Spatio-Temporal Variations Analysis of Yangtze River Water Clarity from 2017 to 2020 Based on Sentinel-2 Images. Remote Sensing, 2021, 13, 2260.

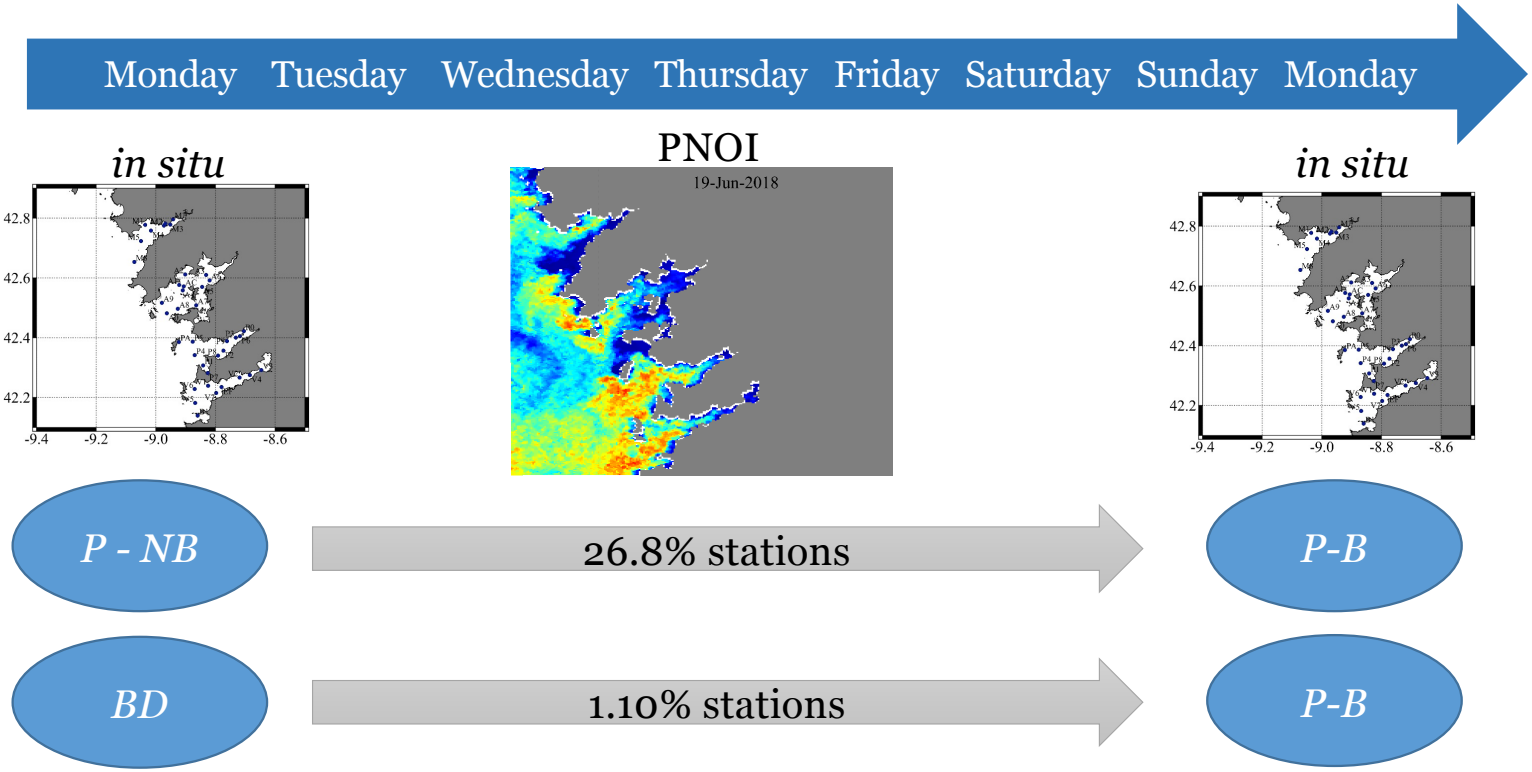
IV: Detection of *Pseudo-nitschzia* spp. from OLCI – the PNOI algorithm



A new algorithm using support vector machines to detect and monitor bloom-forming Pseudo-nitzschia from Sentinel-3 OLCI data (to be submitted)

IV: Detection of *Pseudo-nitschzia* spp. from OLCI – the PNOI algorithm in the independent dataset:

	Sens.	*Spec.*	*Prec.*	*TSS*	*F1*	*AUC*
PNOI BD/P	0.70	0.63	0.79	0.32	0.74	0.68
PNOI NB/B	0.72	0.79	0.37	0.51	0.48	0.80



Dragon 5 Mid-term Results Reporting - Results

V: Detection of *Alexandrium minutum from MSI*

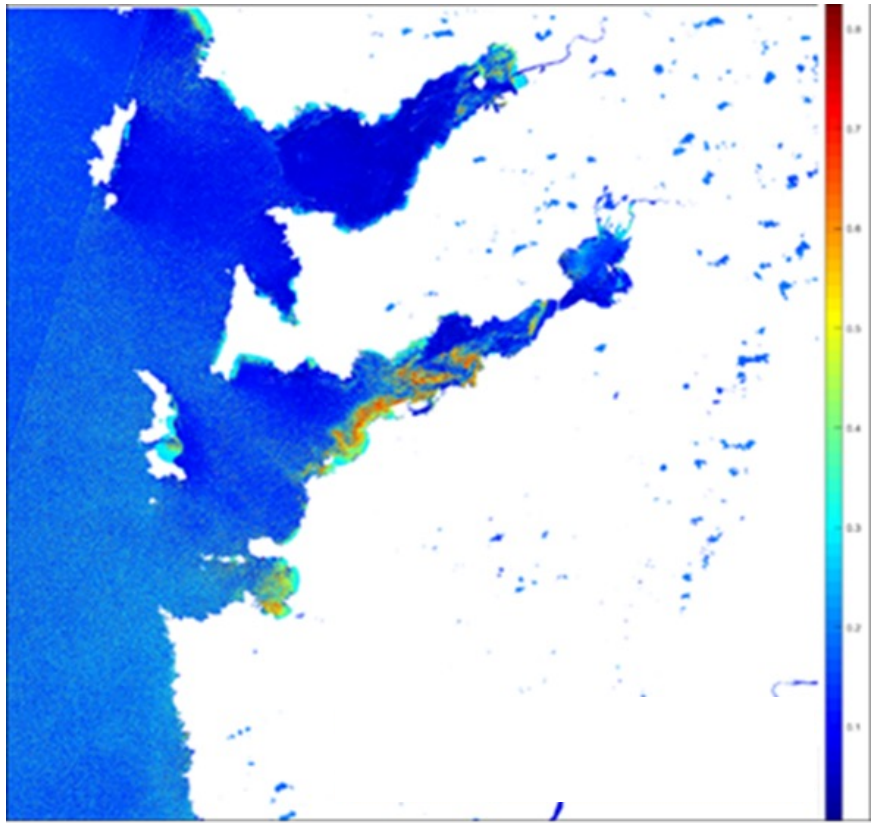
25 match-ups with in-situ hyperspectral AOPs and IOPs

A. minutum concentrations up to 22,7486 cells/L

⬇

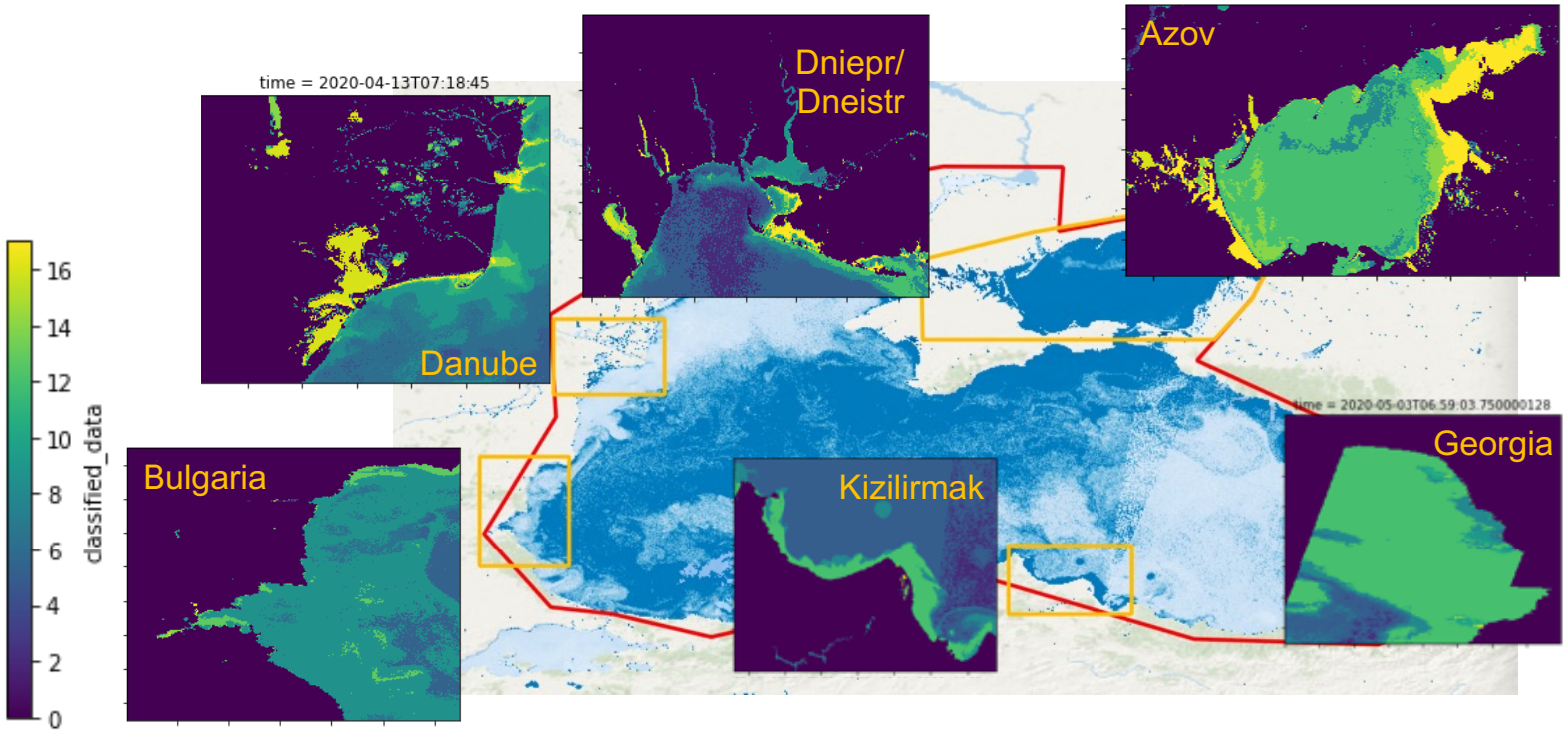
MSI band simulations radiative transfer modelling based on the in-situ data ➡

Performance measures	
R^2	0.79
MPE	0.21
VAR	0.45
RelRMSE	30.90%



European Young scientist (Conor McGlinchey) is further developing this

VI: Optical Water types in the Black Sea



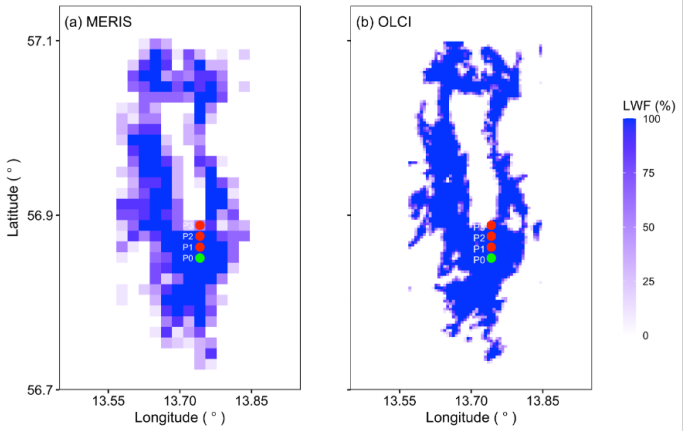
Analysis and results by Liz Atwood from Plymouth Marine Laboratory

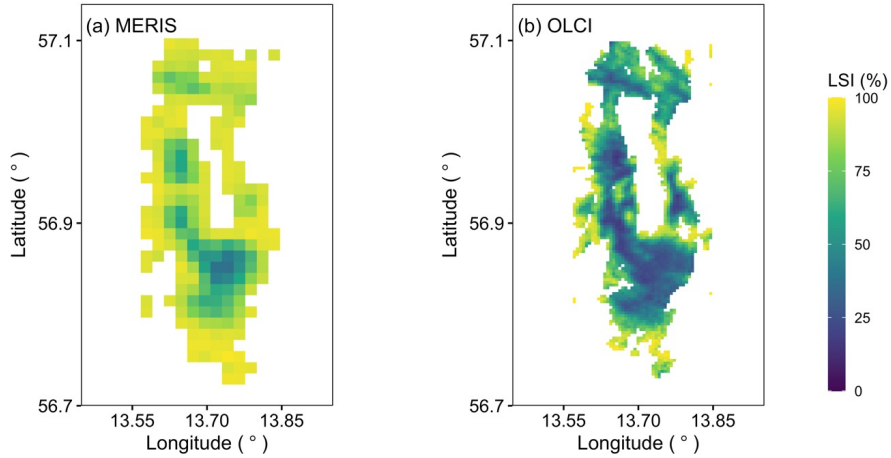
VII: SuperDove for cyanobacteria

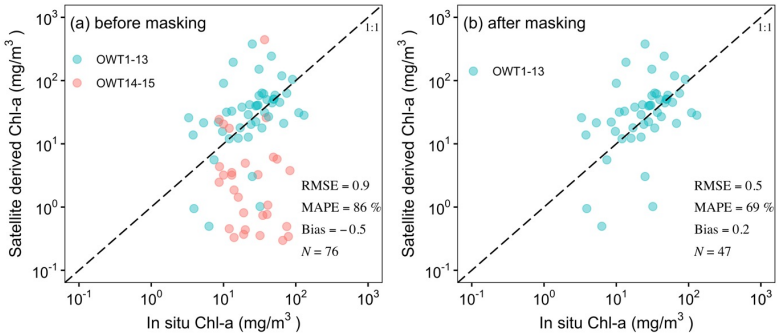
Planet Labs image over the Aithey loch at the University of Stirlin
Image processed by Daniel Atton Beckmann.

Dragon 5 Mid-term Results Reporting - Results

VIII: Adjacency effects in nearshore waters





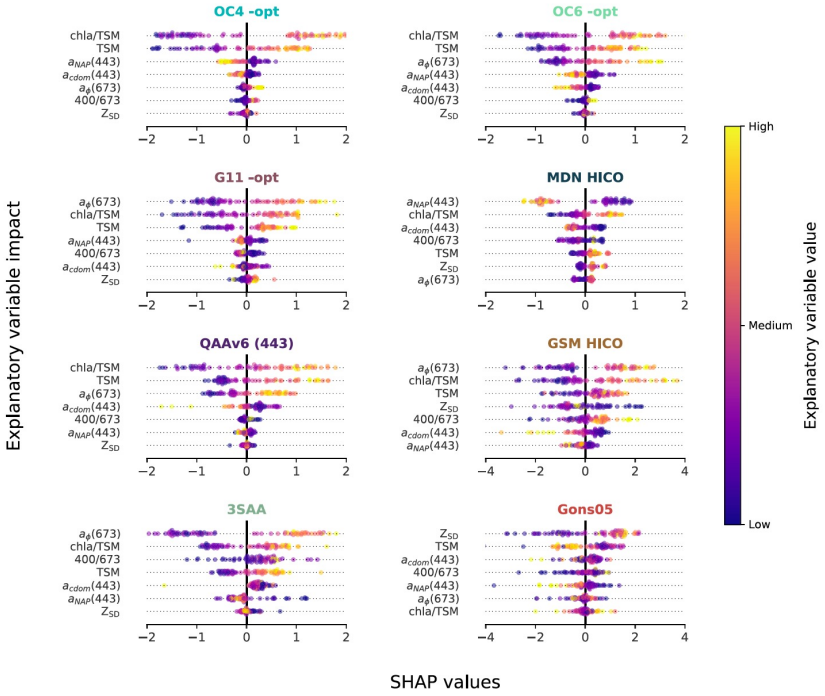


A data-driven approach to flag land-affected signal in satellite derived water quality from small lakes (submitted for publication)

Dragon 5 Mid-term Results Reporting - Results

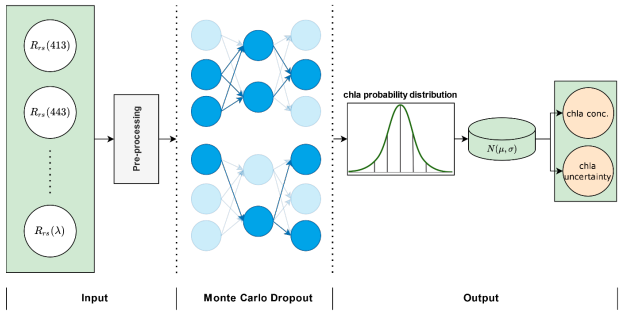
IX: Uncertainty estimates

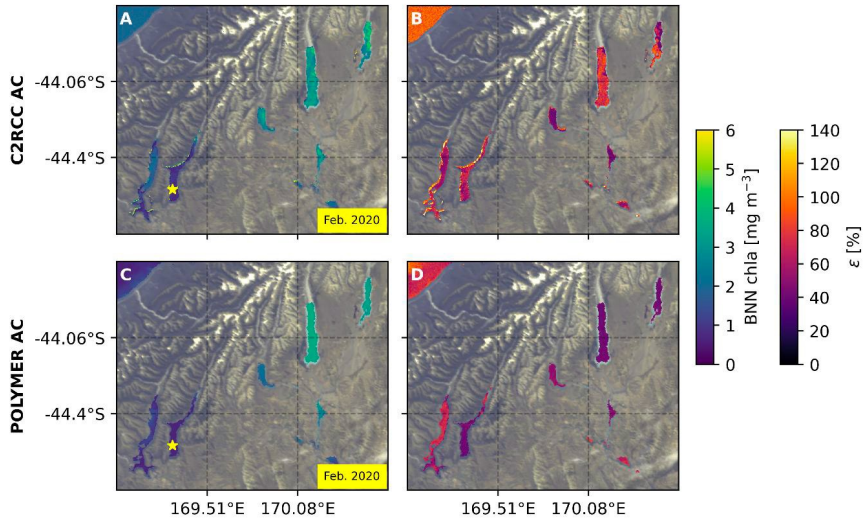
- Retrieval uncertainty



Werther et al (2022) ISPRS J Phot Rem Sen

- Embedded uncertainty



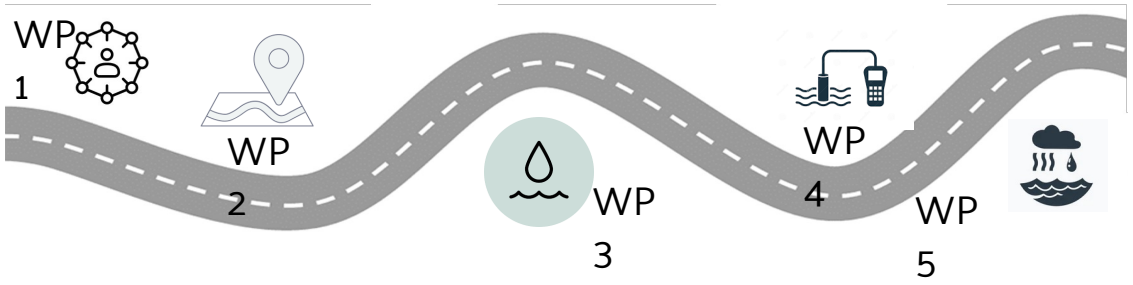


Werther et al (2022) Rem Sen of Env

X: Water-ForCE

Water scenarios For Copernicus Exploitation

Develop a roadmap on the next phase of Copernicus inland and coastal water Services



Water-ForCE is a Coordination and Support Action (CSA) that has received funding from European Union's Horizon 2020-research and innovation programme under grant agreement number: 101004186.

XI: International partner collaboration

INTERWATER

InterWater: *International collaboration to support SDGs through Earth observation of Global Waters*

2022-2023 Call for Global SDG Partnership

CBAS- International Research Center of big data for sustainable development goals

European Young scientists contributions in Dragon 5

Name	Institution	Poster title	Contribution
Conor McGlicnchey	Registered at University of Stirling but co-supervised by all Dragon partners	Characterising and monitoring phytoplankton properties from satellite data	Starting his PhD in October 2022

Dragon 5 Mid-term Results Reporting – Plans for next year

- **Year 1 of young scientist's PhD :** Development of the research proposal review and science plan, sites selection and initial training in research design, data analytics, radiative transfer modelling, machine learning and EO. Initial collection of ground data and identification of data gaps
- Algorithm development and testing
- Publish co-authored paper on PSC and HABs algorithm
- Explore the possibility of young Scientist to visit the Chinese partners

Thank you for tuning in

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Group leader – Earth and Planetary Observation Sciences
Deputy Associate Dean (Internationalisation)
University of Stirling
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