

# Delivering resilience to climate-related impacts on water quality through Earth observation

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UK Research  
and Innovation



## UKCR Project Team

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Prof Marion Scott & Prof Claire Miller | University of Glasgow  
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## Background Science

UKRI NERC GloboLakes (including Plymouth Marine Laboratory, University of Dundee,  
University of Reading)



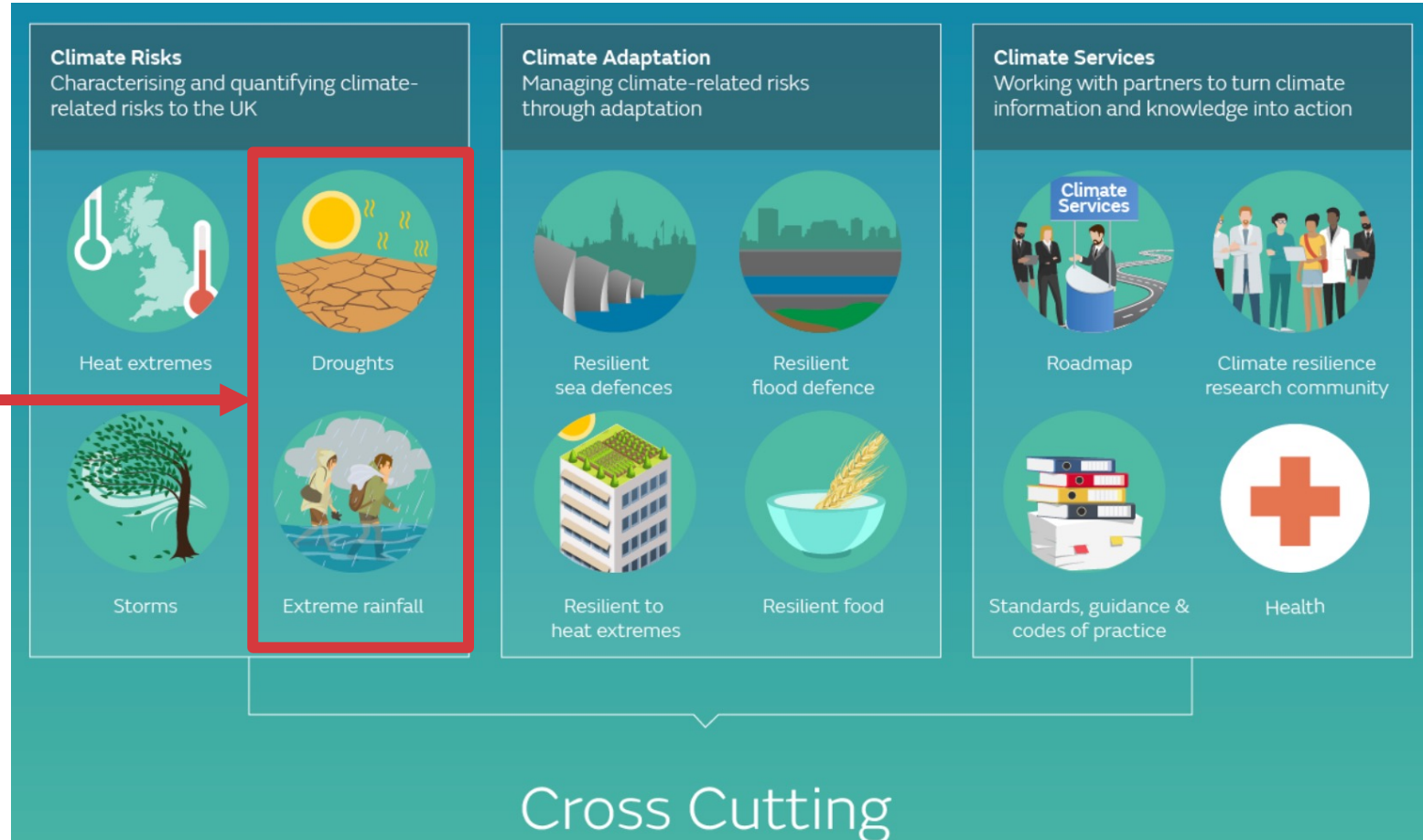
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# Climate effects on water quality



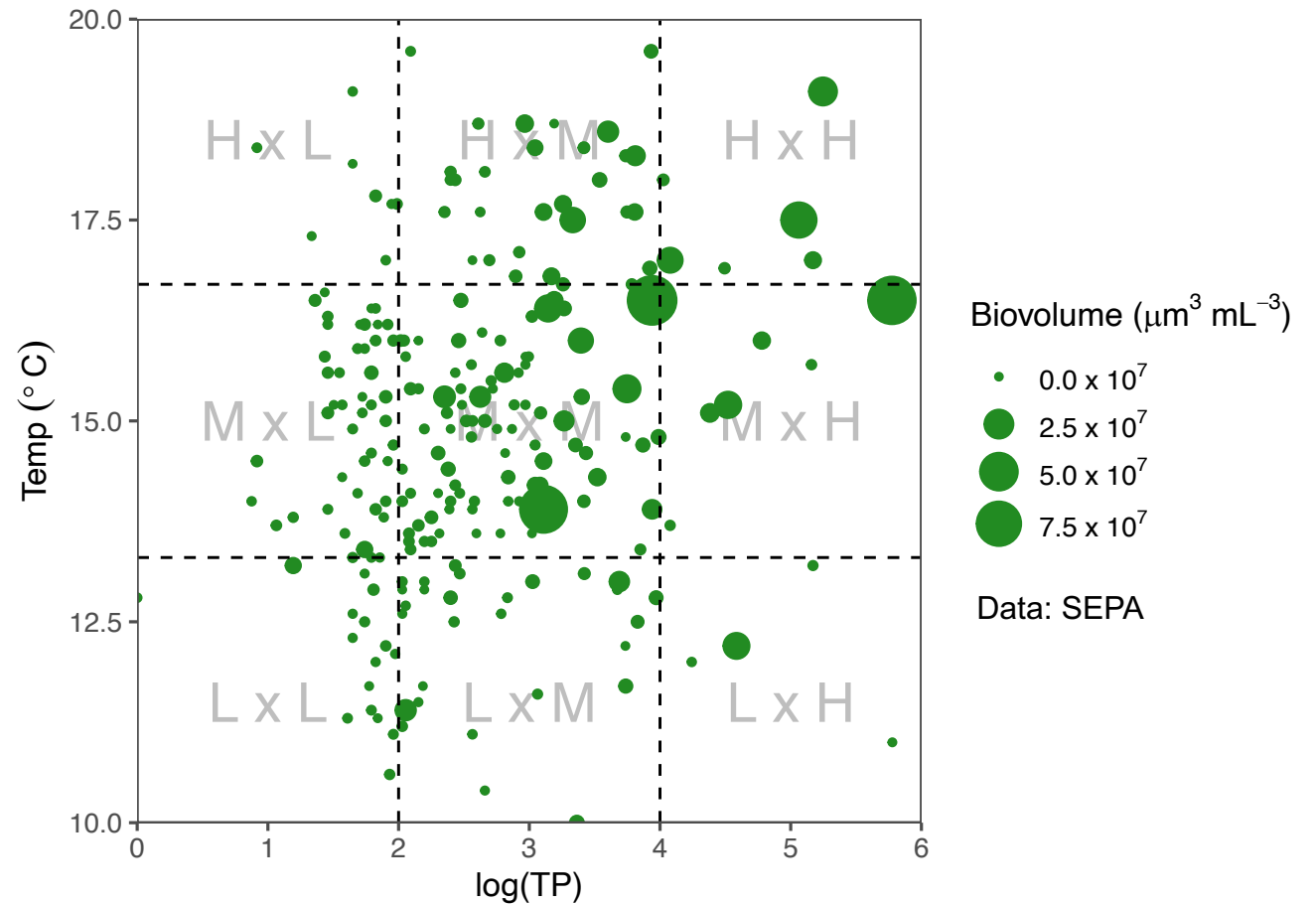
Impacts on water quality are an often-overlooked dimension of climate change



# Cyanobacteria, nutrients and climate



- Cyanobacterial blooms occur annually throughout the UK
- Main drivers of blooms are nutrients and climate (temperature and drought (flushing))
- Blooms pose risks to water security and human and animal health



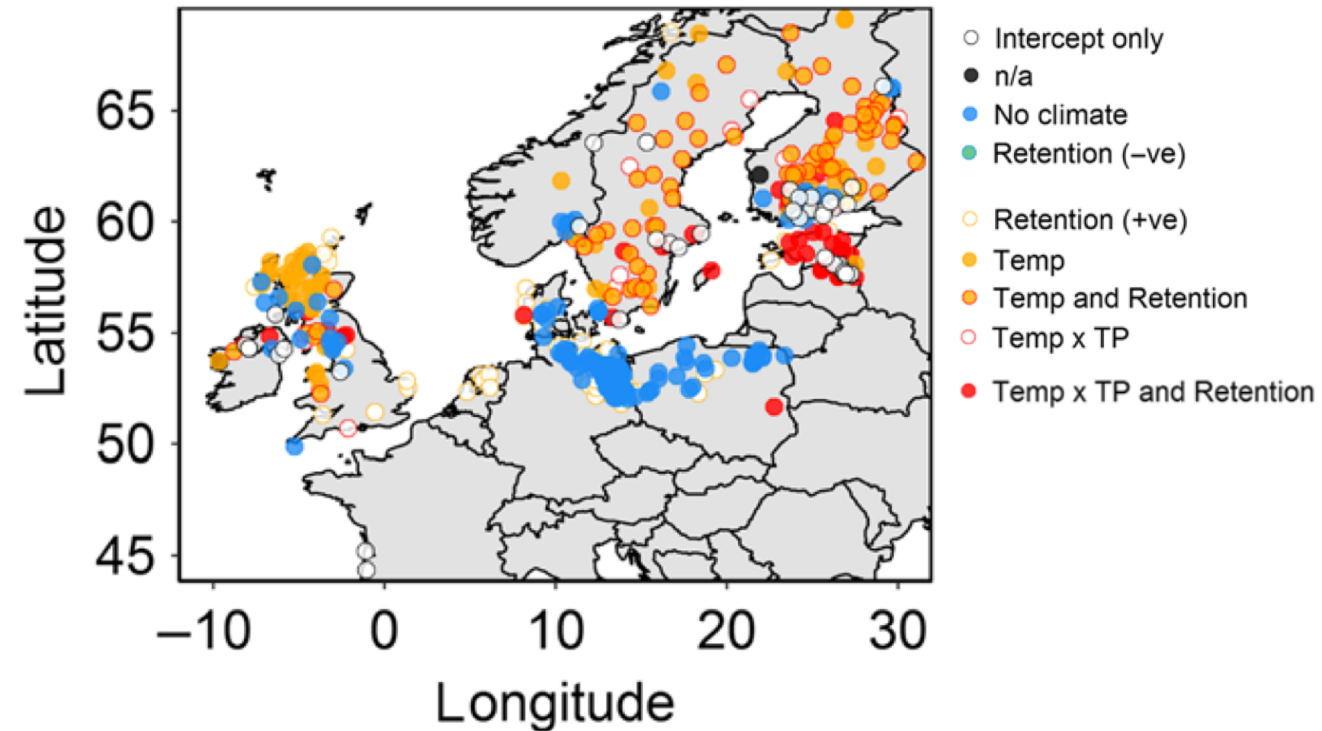
**Right:** Effect of phosphorus and temperature on cyanobacterial biovolume in Scotland [Data: SEPA]



# Will warming promote blooms in UK?



- UK lakes and reservoirs (>55°N latitude) vulnerable to climate-related increases in blooms
- But lack of systematic, proactive monitoring to detect climate-related changes in bloom occurrence



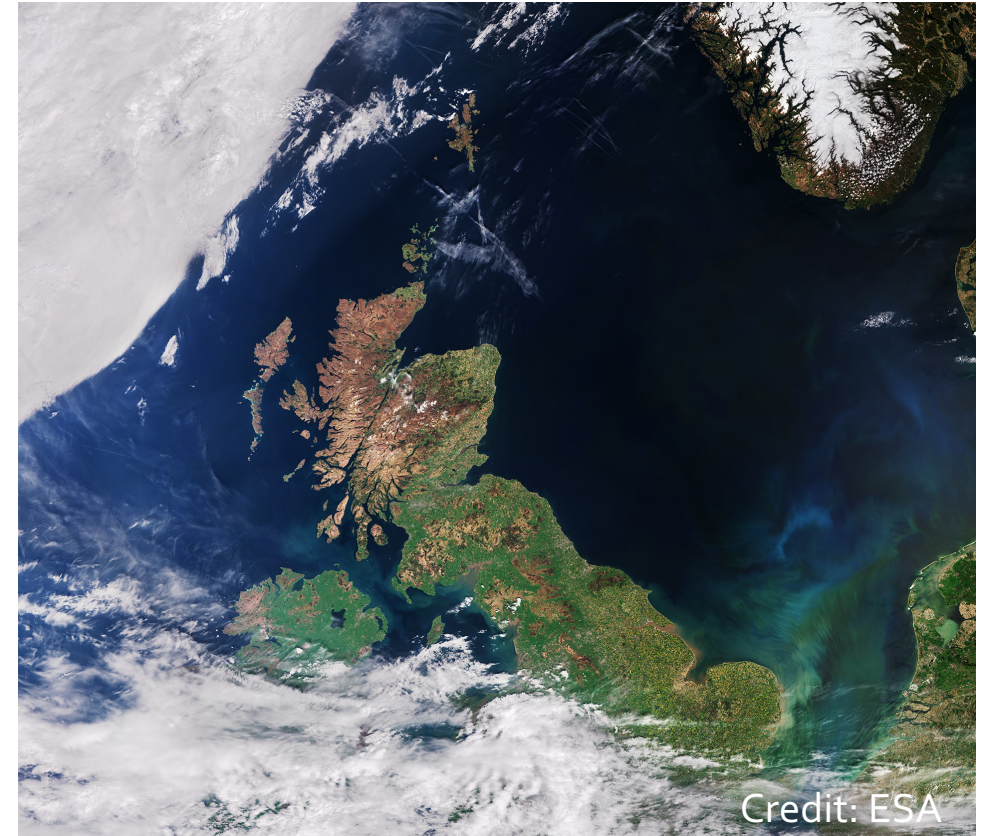
**Right:** Effect of temperature and lake retention time on the occurrence of cyanobacterial blooms in European lakes [Richardson et al. 2018. *Global Change Biology*, 24(11)]

# Monitoring water quality using Earth observation (EO)

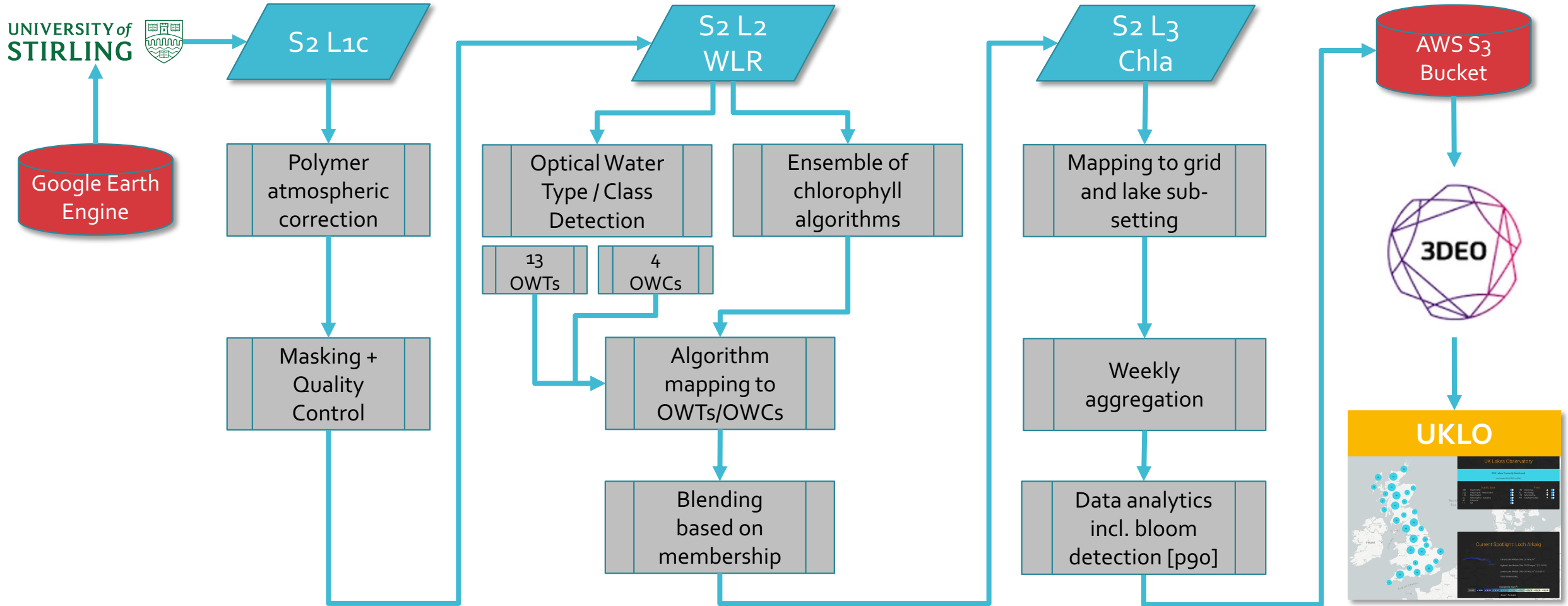


- Can we develop a UK climate service for bloom monitoring using EO?
- UK lakes too small to observe with ocean colour satellites (e.g., S3 OLCI)
- Sentinel-2A/B MSI offers higher spatial resolutions but poorer imaging capabilities (e.g., no orange band for PC)

**Right:** ESA's Sentinel-2A/B spacecraft carrying the 12 channel MultiSpectral Instrument (MSI) sensor with spatial (pixel) resolution of 10-60 m and 5-day revisit at equator (two satellites)



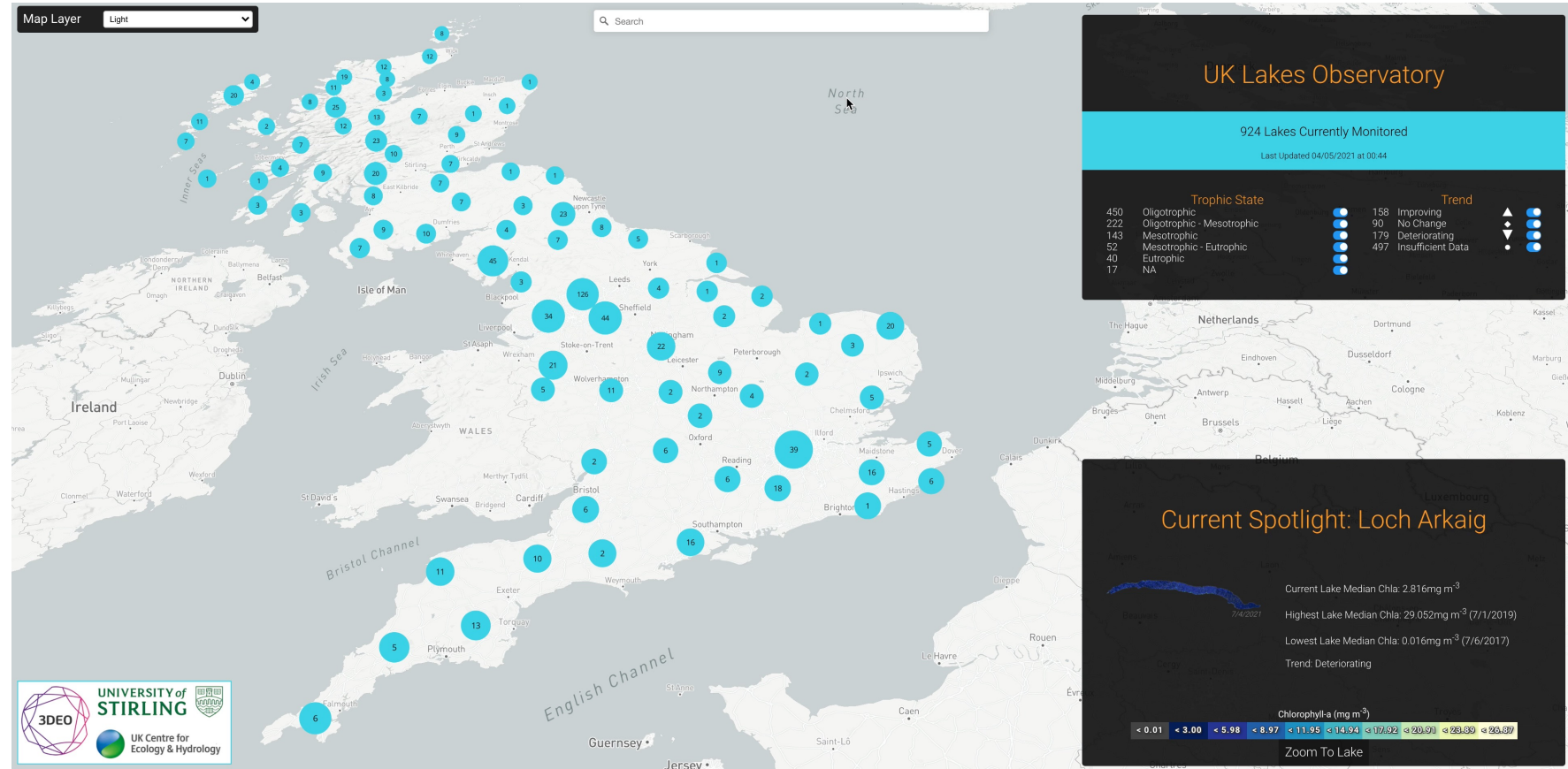
# UKLO processing chain [v.1.0]



# UK Lakes Observatory (UKLO)

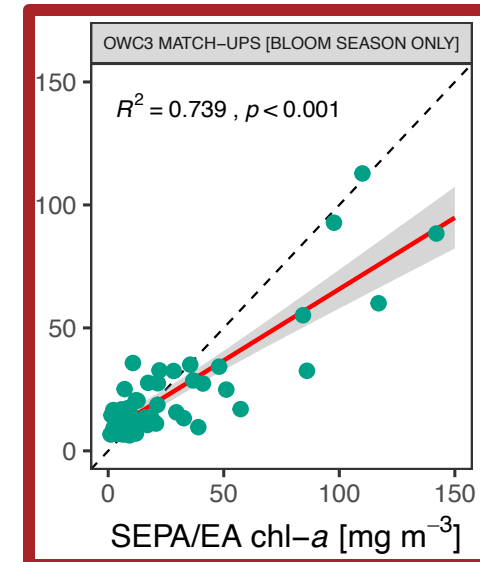
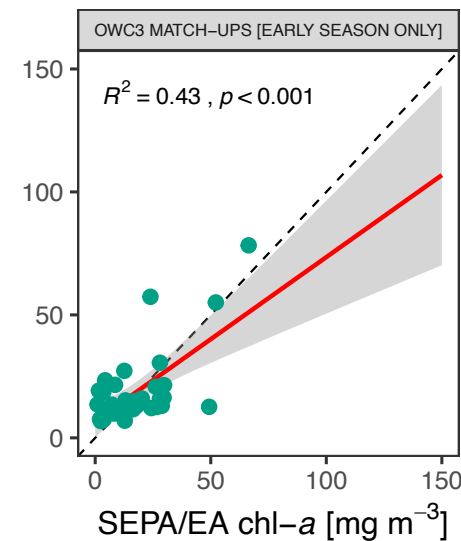
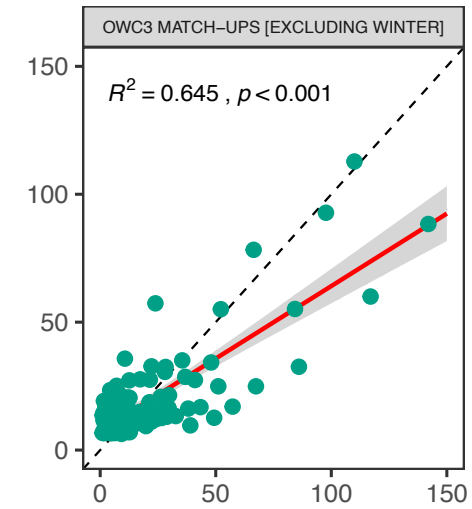
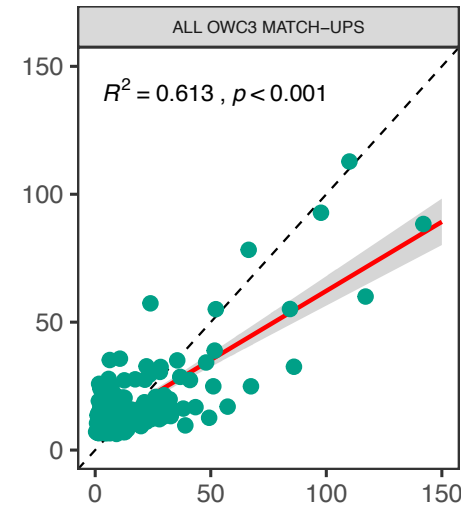
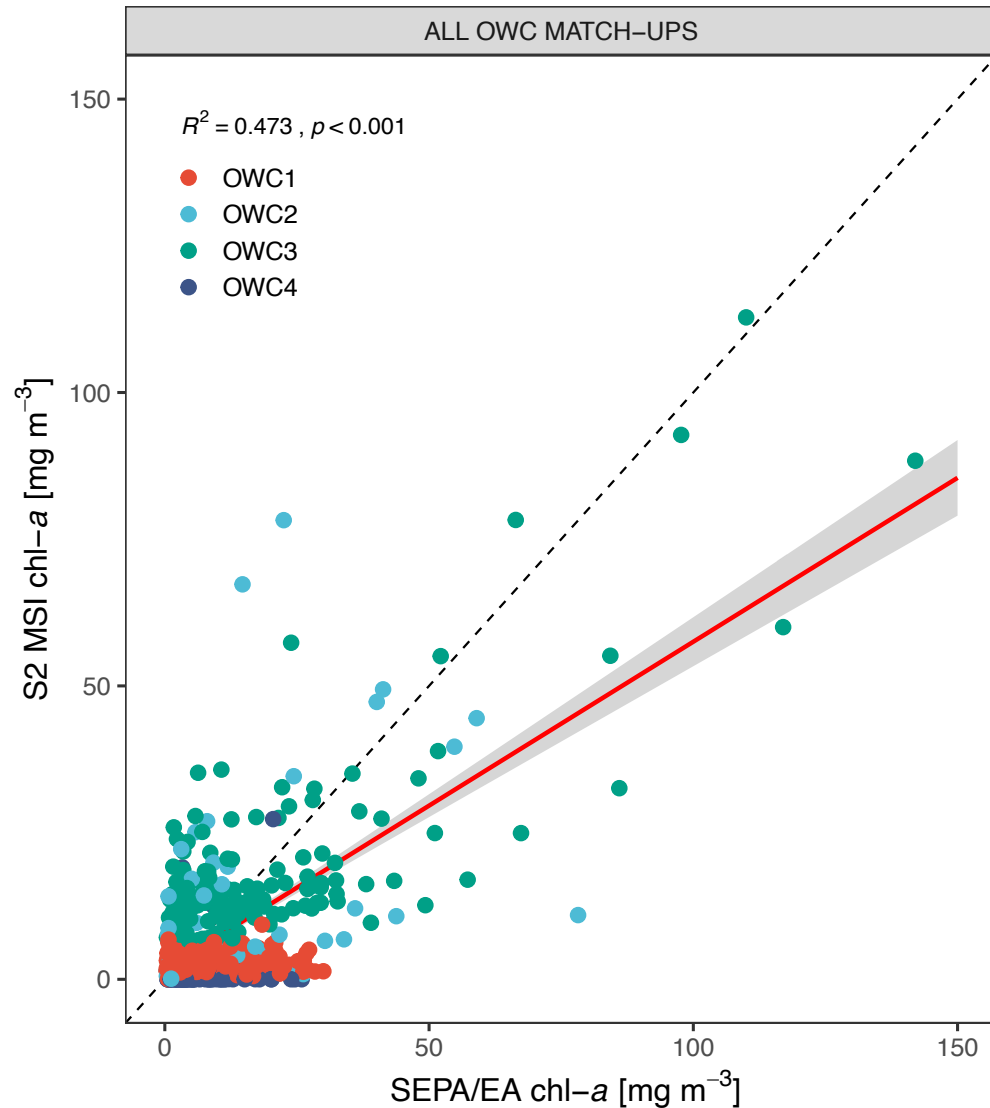


- Data produced and visualized weekly
- Simple data analytics (e.g., bloom event monitoring, change detection)
- Provision for real-time email/SMS alerts to water managers

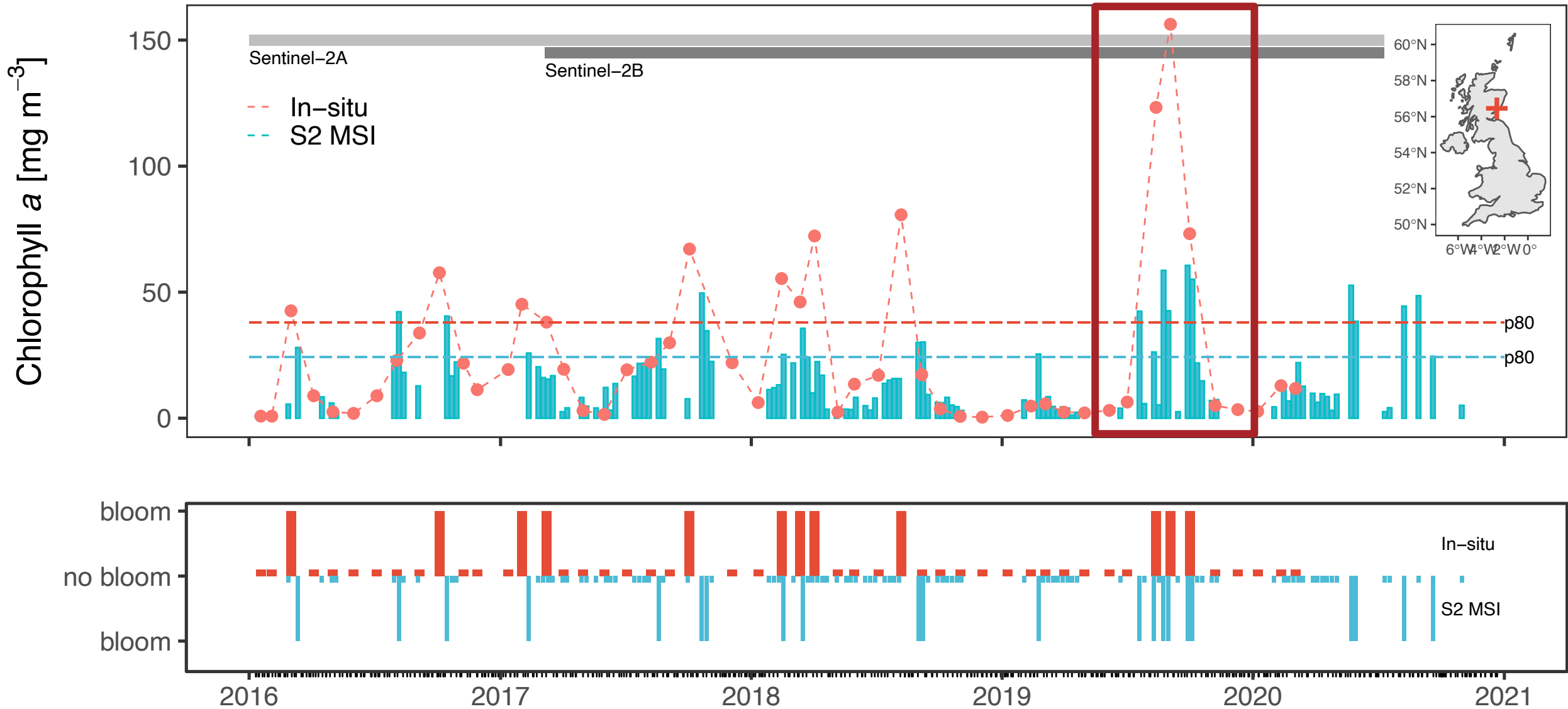




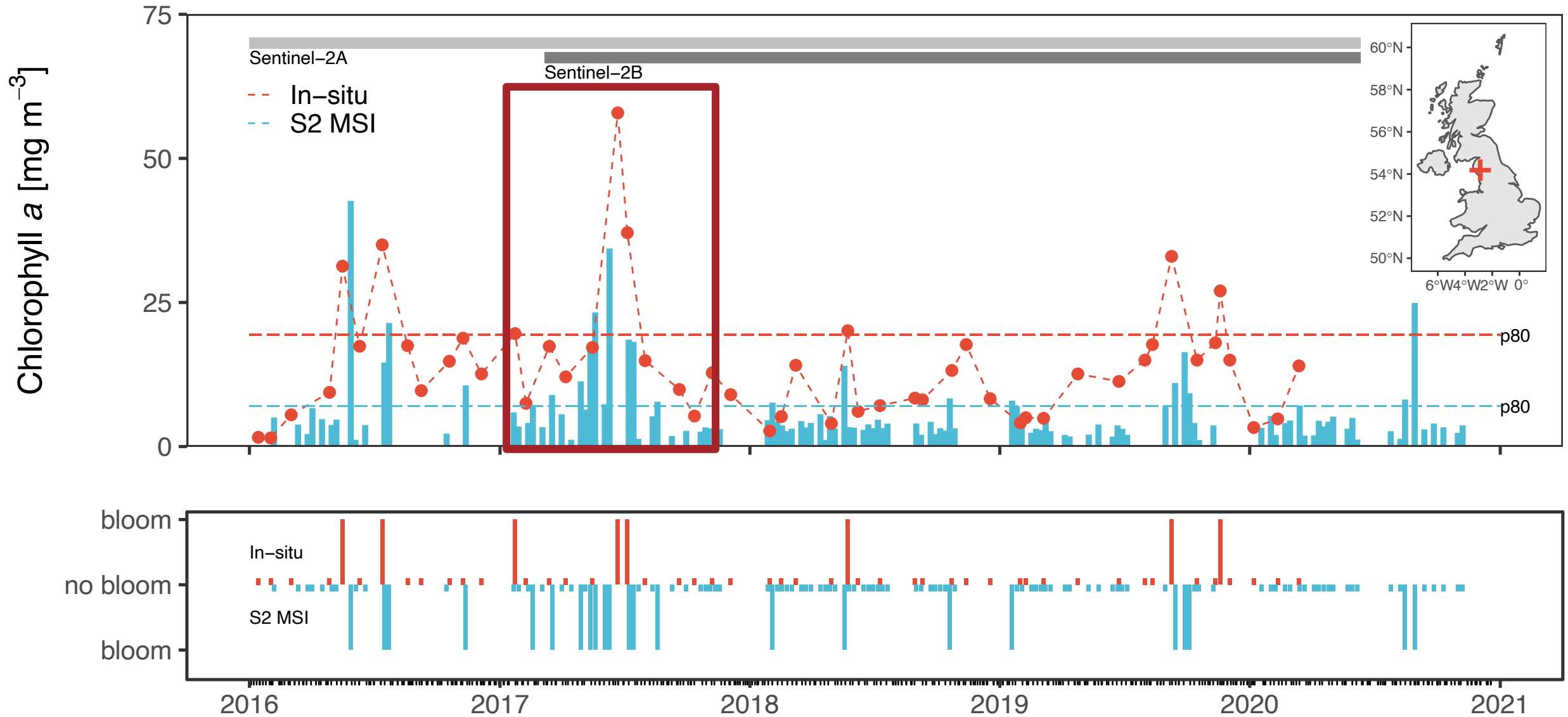
# Comparison against in-situ monitoring data



# Case study: Rescobie Loch



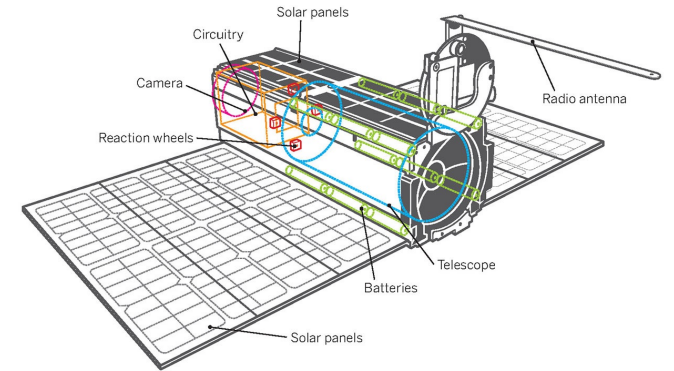
# Case study: Esthwaite Water



# Future work



- New atmospheric correction models, optical water classification schemes, and retrieval algorithms
- Planet SuperDoves (Flock 4s) – 48 launched on SpaceX in January 2021



**Right:** Planet’s Dove nanosatellites with the spectral band configuration for the latest generation of ‘Super Doves’.

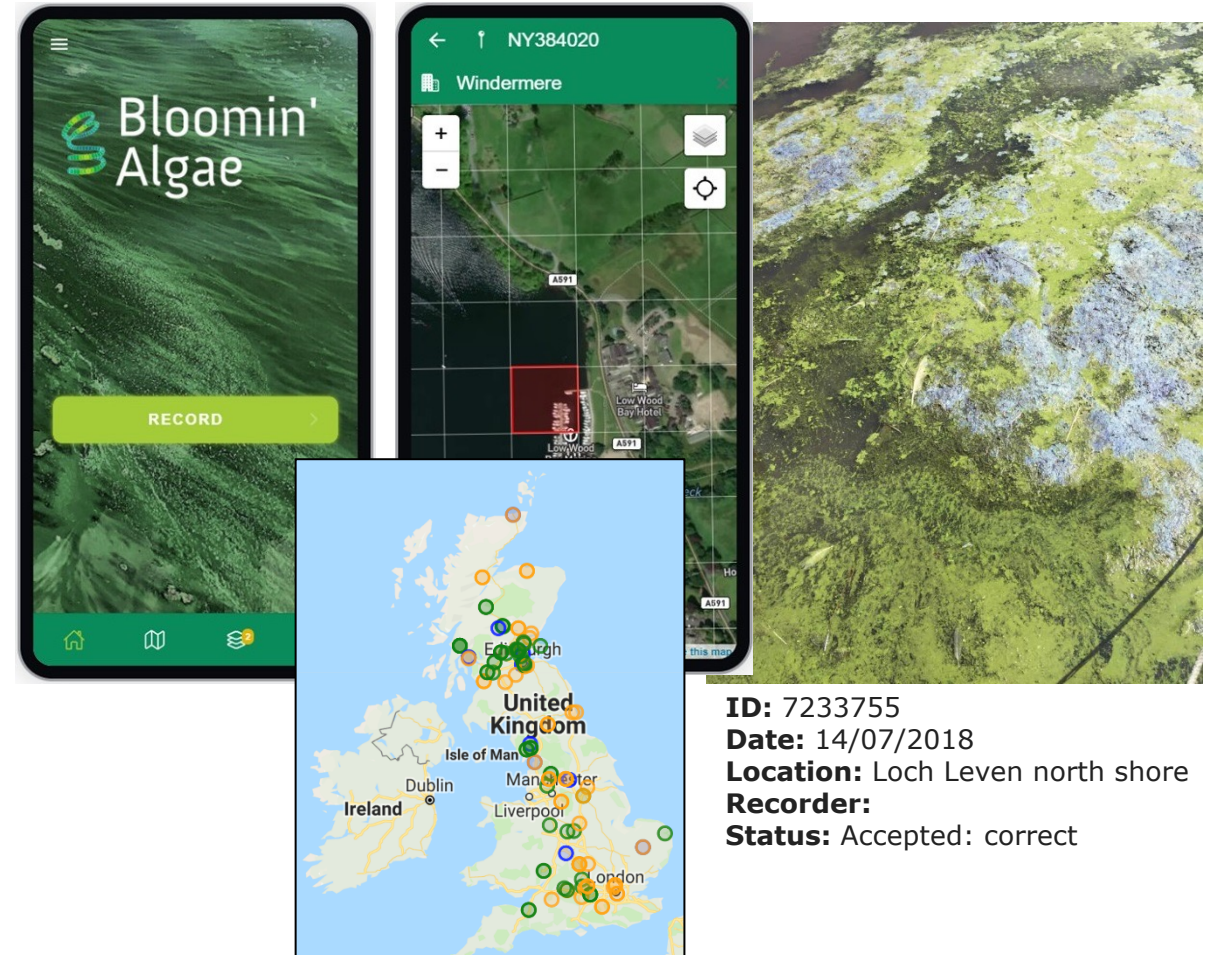
Band	Name	Notes	Wavelength (fwhm)	spatial sampling	GSD (m)	$L_{ref}$ ( $W sr^{-1}um^{-2}$ )	SNR @ $L_{ref}$ ( $t=10ms$ )*
1	Coastal Blue	core visible bands	443 (20)	0.25x	12	130	193
2	Blue		490 (50)	1x	3	130	170
3	Green I		531 (36)	1x	3	130	150
4	Green II		565 (36)	1x	3	130	154
5	Red		665 (31)	1x	3	130	138
6	Yellow	sediments, PC	610 (20)	1x	6	70	63
10	Red edge I	important for data compatibility with Sentinel-2	705 (15)	1x	6	70	57
13	NIR	narrow NIR	865 (40)	0.5x	6	130	137



# Integration with in-situ monitoring networks



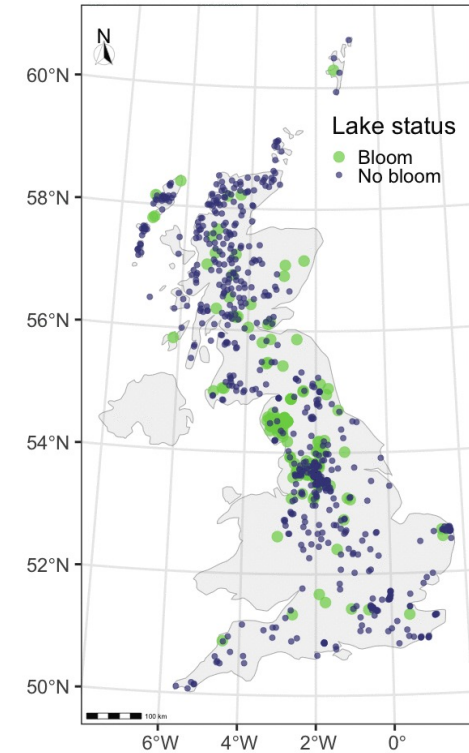
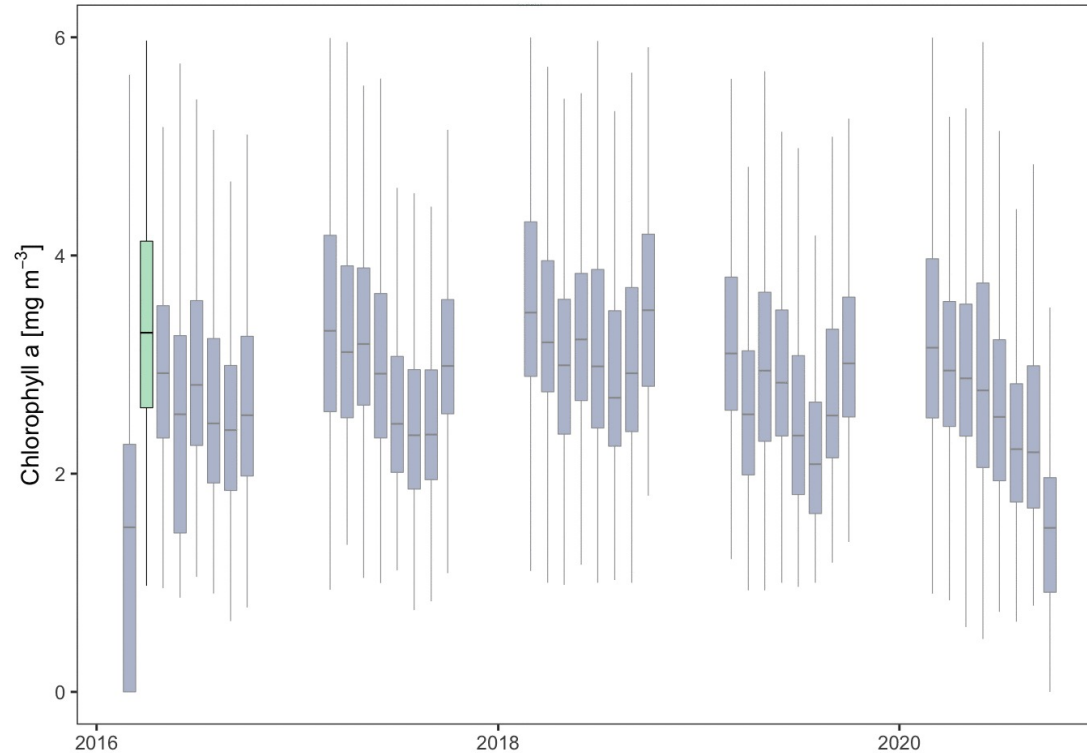
- UK CEH Bloomin' Algae citizen science app
  - Opportunities for public engagement to integrate EO observations into app
  - Complementary (spatial resolution) and supports cross-validation
- Smart IoT digital observatories



# Summary



- Widens surveillance and increases likelihood of blooms being detected
- Complementary to existing in-situ monitoring (agencies, citizens, IoT sensors)
- Contribute to improved understanding of climate impacts on water quality at the UK-scale



# Contact details

**Website:** [www.ukclimateresilience.org](http://www.ukclimateresilience.org)

**Twitter:** @UKCRP\_SPF

**YouTube:** UK Climate Resilience programme



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