

NERC Knowledge Exchange Fellowship: Exploitation of satellite remote sensing for regulation and monitoring of inland water quality

Dr Claire Neil, Biological & Environmental Sciences, University of Stirling GloboLakes Workshop 29th – 31st Aug 2018, Stirling



NERC Knowledge Exchange Fellowship

- Fellowship funded by NERC and supported by Satellite Applications Catapult with the aim of promoting and facilitating the use of **satellite remote sensing** for improved **regulatory monitoring** of inland and TRAC water quality.
- Building on and contributing to other research projects (GloboLakes, EOMORES etc.).
- UK's first practical application of satellite data being used for statutory, operational monitoring.



SCIENCE OF





















GloboLakes Workshop 29th – 31st Aug 2018, Stirling





1) Optical water type classification

- Remote sensing reflectance (Rrs) spectra assigned an OWT by calculating Mahalanobis distance.
- 13 distinct optical water types identified in global dataset.



- Assessed algorithms for calculating Chla, TSM and CDOM.
- Best performing algorithms per OWT combined in an ensemble switching algorithm for improved accuracy.



SCIENCE O

NERC 2-phase KEF





Feasibility study with SEPA to develop concept (February 2018 – January 2019)

- 1. Retune GloboLakes Chla algorithm
- 2. Produce maps of Chla concentration in Scottish lochs
- 3. Define a WFD satellite derived classification metric (e.g. adapted EQR boundaries).







Feasibility study with SEPA to develop concept (February 2018 – January 2019)

- 1. Retune GloboLakes Chla algorithm
- 2. Produce maps of Chla concentration in Scottish lochs
- 3. Define a WFD satellite derived classification metric (e.g. adapted EQR boundaries).

KEF to deliver change (January 2019 – December 2021)

- 1. Extend to a **multi-parameter** processing chain for Chla plus CDOM, turbidity and TSM (Google Earth Engine)
- 2. Increase geographical extent to cover UK and Ireland
- **3.** Additional partners: SEPA plus EA, IEPA, NRW, Scottish Water, Anglian Water
- 4. Implement maps for operational use in water quality applications.



An operational algorithm for UK waters



GloboLakes chlorophyll-*a* (Chla) algorithm **retuned for Scottish** waters and Sentinel-2 sensor.

SCIENCE O

Preliminary results show Chla derived from satellite data compare well with ground-sample results.

GloboLakes Workshop 29th – 31st Aug 2018, Stirling



Number of cloud free days (Loch Leven example)



Month



SCIENCE

Routine monitoring capability (2)

NERC SCIENCE OF THE ENVIRONMENT

Number of pixels per lake









Number of observable lakes



Google Maps

Sentinel-2 image

Sentinel-2 overlayed with SEPA WFD waterbodies

SCIENCE

Many more lakes observable using Sentinel-2, particularly useful in areas inaccessible for ground-sampling.

GloboLakes Workshop 29th – 31st Aug 2018, Stirling



Factor	SEPA ground sample	Sentinel-2
Number of samples per year per lake	~12	~95
Number of lakes sampled per year	60	>1000s
Spatial representation	1 sample location	>10000s pixels
Number of equivalent samples	720	950 x 10 ⁶

Sampling (+ WFD regulations etc.) are designed to **seek the truth** about water quality. Is this really what current monitoring methods are showing? Satellite remote sensing provides a **more representative overview** of the complete lake environment.





As direct input into WFD classification

To optimise reservoir management for efficient water treatment and early detection of quality issues As a sampling management tool to optimise ground-based measurements

To identify regions of potential risk to water quality status

And many more...





Thank you

Dr Claire Neil **Research Fellow** University of Stirling **Biological & Environmental Sciences** claire.neil@stir.ac.uk





