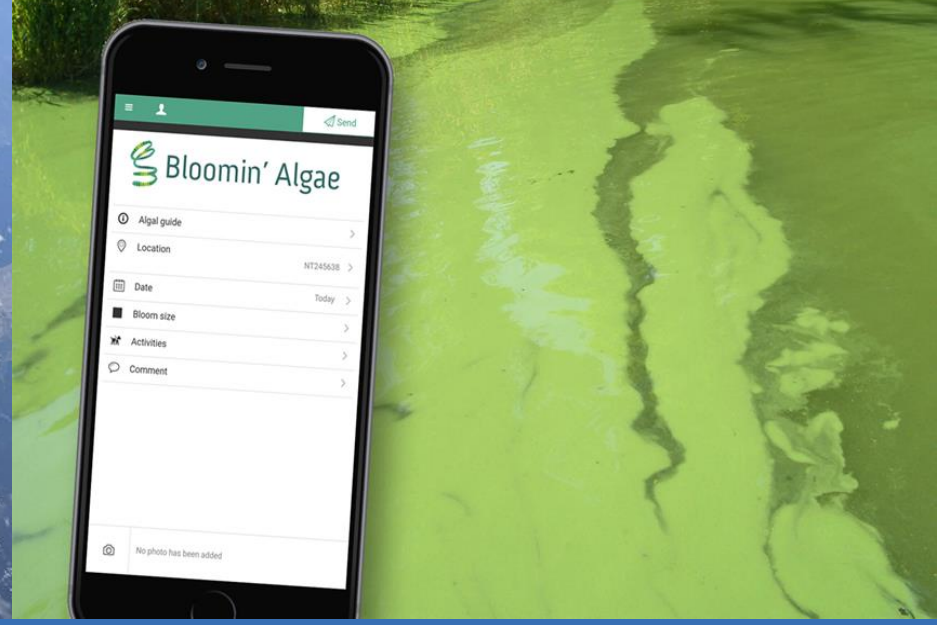

Discussion Group 3:
Enhanced monitoring through technical innovation and citizen science

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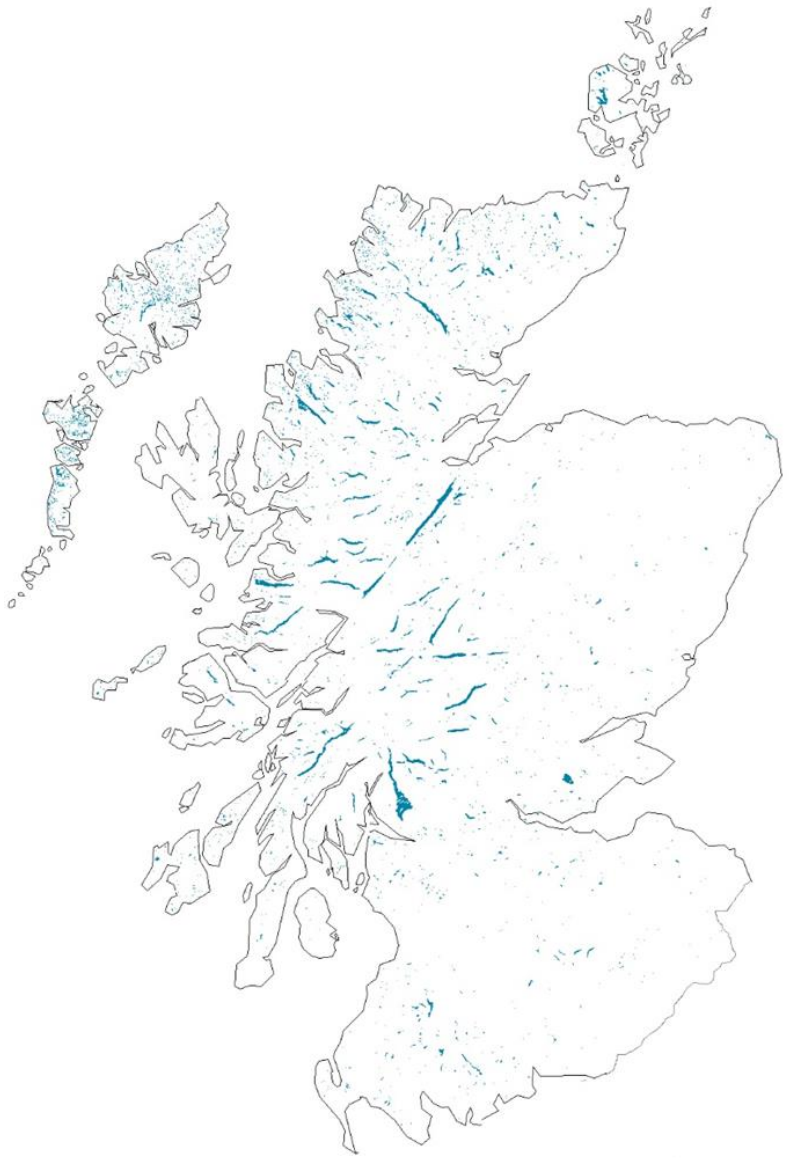
UNIVERSITY of STIRLING

CEH Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

Challenges for monitoring impacts of water scarcity in Scotland



- >25,000 lochs
- >50,000 km of rivers
- <1% monitored by SEPA per year
- Monitored once per month at best

- Droughts and water scarcity vary in frequency, intensity, spatial extent and duration
- Impacts and recovery not explicitly monitored

Source: UK Lakes Portal https://eip.ceh.ac.uk/apps/lakes/

Impacts of Drought and Water Scarcity

Loss of horizontal connectivity
Margins recede

Loss of longitudinal connectivity
Flow stops

Environmental Impacts

- Reductions in connectivity
- Extreme temperatures
- Deterioration in water quality (algal blooms)
- Biodiversity loss
  - Low ecological resistance (impact)
  - High ecological resilience (recovery)

Socio-economic Impacts

- Closure of water supply reservoirs & fisheries
- Increased treatment costs
- Reduced recreation opportunities

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Why use Citizen Science for monitoring impacts?

Pros

- Large spatial coverage and high frequency
- Rapid response/feedback to “events”
- Sophisticated geo-tagged image data

Cons

- Measurement quality
- Sampling bias

Bloomin’ Algae - Citizen Science app

https://www.ceh.ac.uk/algal-blooms/bloomin-algae

Download on the App Store

ANDROID APP ON Google play

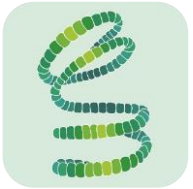
31% Accepted

18% Rejected

51% Plausible

- Big savings on monitoring costs
- Notification service to SEPA & LAs
- Rapid feedback on risks to public

Citizen science: benefits and challenges



Benefits to Public

- Empowers individuals and communities
- Reduces health impacts

Benefits to Agencies (SEPA & HPS)

- Resource savings for monitoring

Benefits to science

- E.g. Climate drivers and magnitude of impacts

Challenges

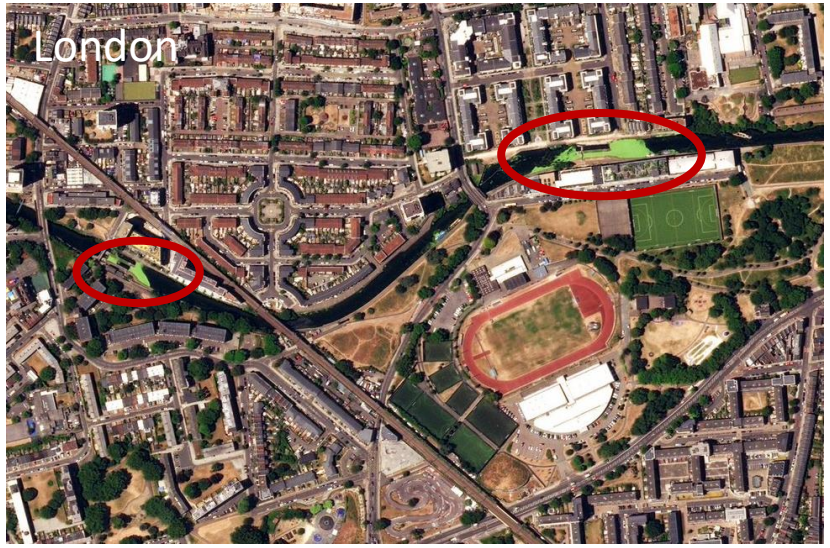
- Data quality
- Operation costs (verification and communication)
- Recruitment and retention of volunteers

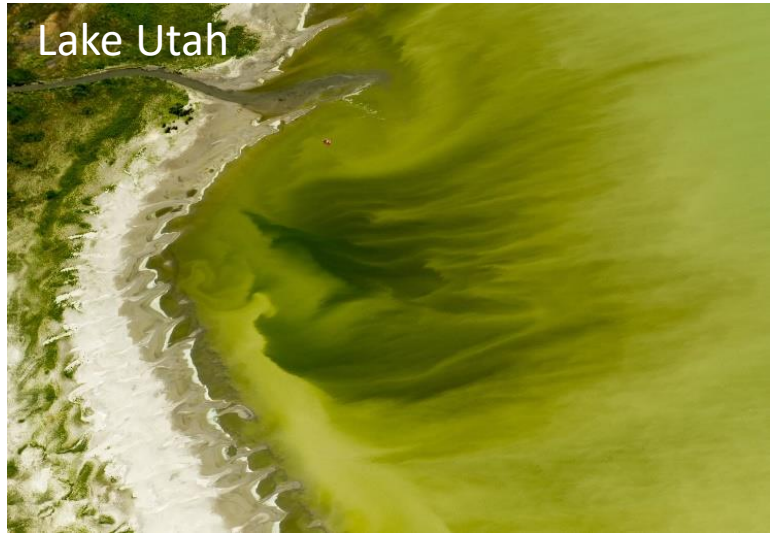
Earth observation as a tool for monitoring drought conditions and impacts

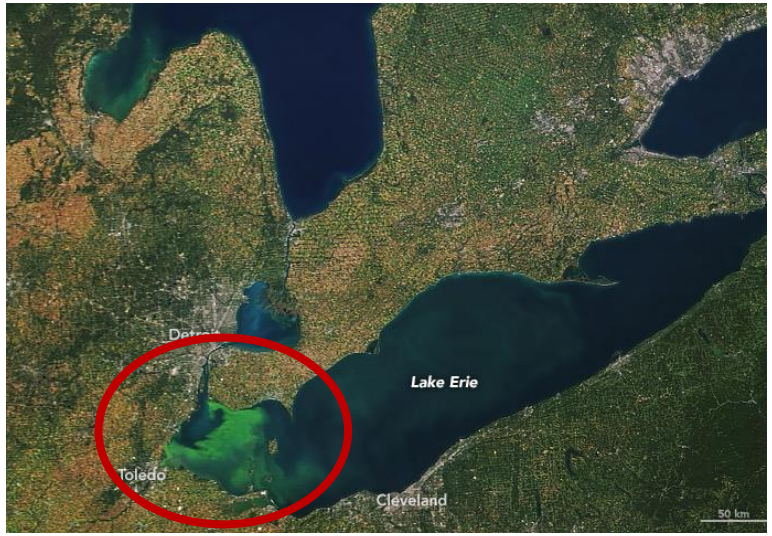
2018 drought impact visible from space: Quantity and quality

Water quantity

Water quality







If you can see it from space, you can quantify it.

Earth observing satellites: opportunity for monitoring water scarcity

Why use satellites?

- Number of environmental parameters,
- Spatial and temporal scales
- Consistent measurements (NRT)
- Comparable across catchments, countries, agencies, industries.

Current Earth observation data-driven applications

Water quality	Water quantity
GloboLakes: first globally-adaptive processor for estimating biogeochemical parameters from optical satellite data	**DROMAS Agricultural Drought Monitoring and Assessment Driven by Satellites**: feasibility study for periodic monitoring of agricultural vegetation
EOMORES: developing new highly efficient commercial services for operational inland and coastal ecological water quality monitoring	**ESCAP The Drought Mechanism**: enhancing the capacity of governments to use space-based data for effective drought monitoring and early warning
DANUBIUS-RI: delivering an integrated understanding of the functioning of river sea systems to address key societal challenges	**Drought Eye**: Monitoring Thermal Stress in Near Real-time
UNESCO IIWQ World Water Quality Portal: providing information on freshwater quality at the global scale using remote sensing data	**National Integrated Drought Information System**: Groundwater and Soil Moisture Conditions from GRACE Data Assimilation

Knowledge exchange for data uptake

- 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, ORSECT etc.).
- UK's first practical application of satellite data being used for routine monitoring.

SEPA Scottish Environment Protection Agency

Environment Agency

Scottish Water Always serving Scotland

love every drop anglianwater

JNCC Joint Nature Conservation Committee

epa Environmental Protection Agency An Ghníomhaireacht um Chaomhnú Comhshaoil

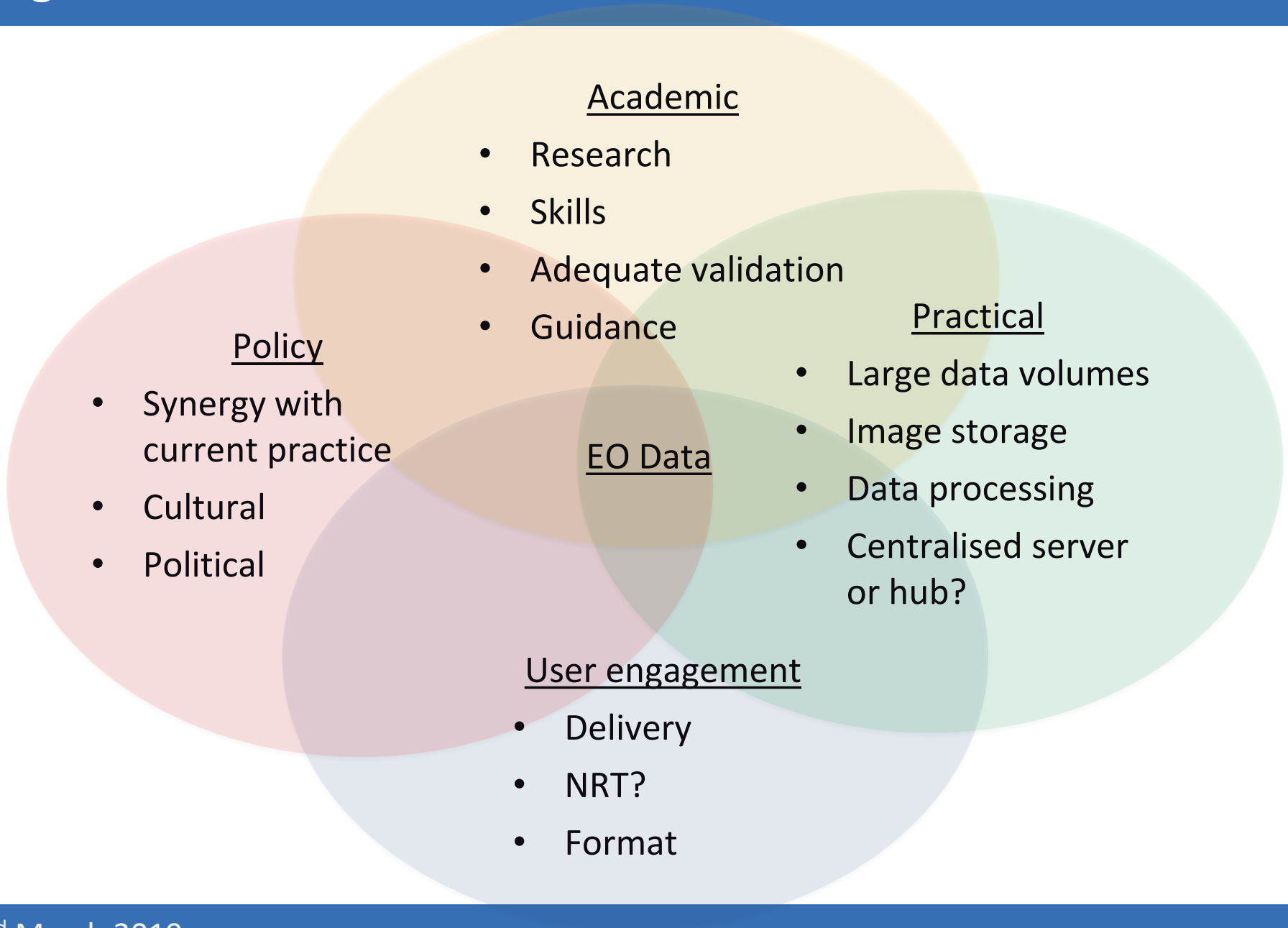
NERC SCIENCE OF THE ENVIRONMENT

CATAPULT Satellite Applications

NATURAL ENGLAND

Cyfoeth Naturiol Cymru Natural Resources Wales

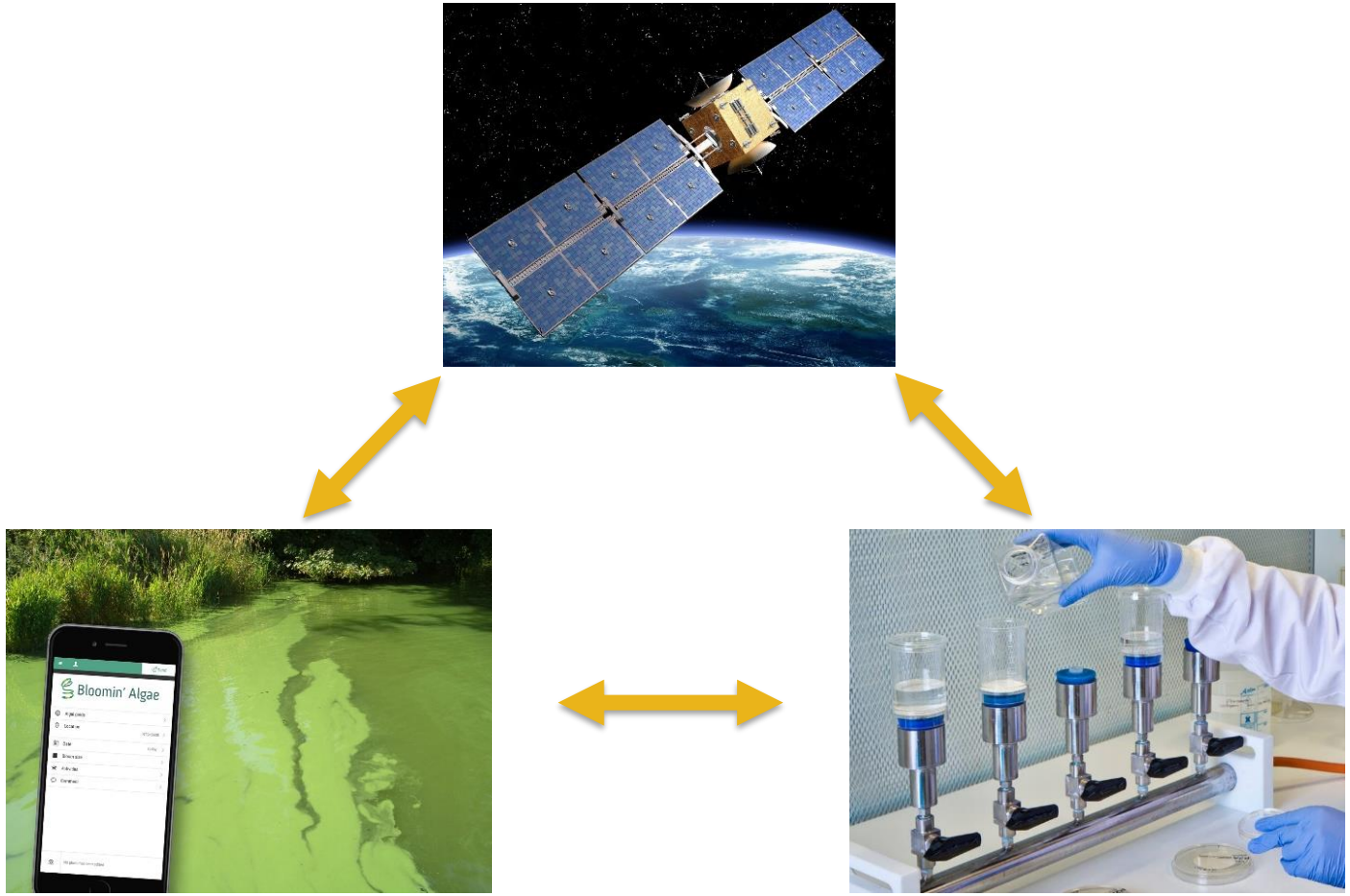
Challenges using Earth observation data



The complete picture: data integration from multiple sources

We need a comprehensive, coherent approach to monitoring that combines data from all sources.

- NERC: Delivering Resilience to Climate Impacts on UK Freshwater Quality
- H2020: Multiscale Observation Networks for Optical monitoring of Coastal waters, Lakes and Estuaries (MONOCLE)



Enhanced monitoring through technical innovation and citizen science

Discussion questions to consider at the 3 breakout sessions:

- What monitoring lessons have we learnt from recent experiences in Scotland?
- What monitoring lessons can we learn from our national and international counterparts?
- How can monitoring data be used to enhance resilience?
- How can communities support monitoring and adaptive management?
- Identifying the 'need' for research – what, when, why and how?