# WP6: Attributing the causes of lake response to environmental change

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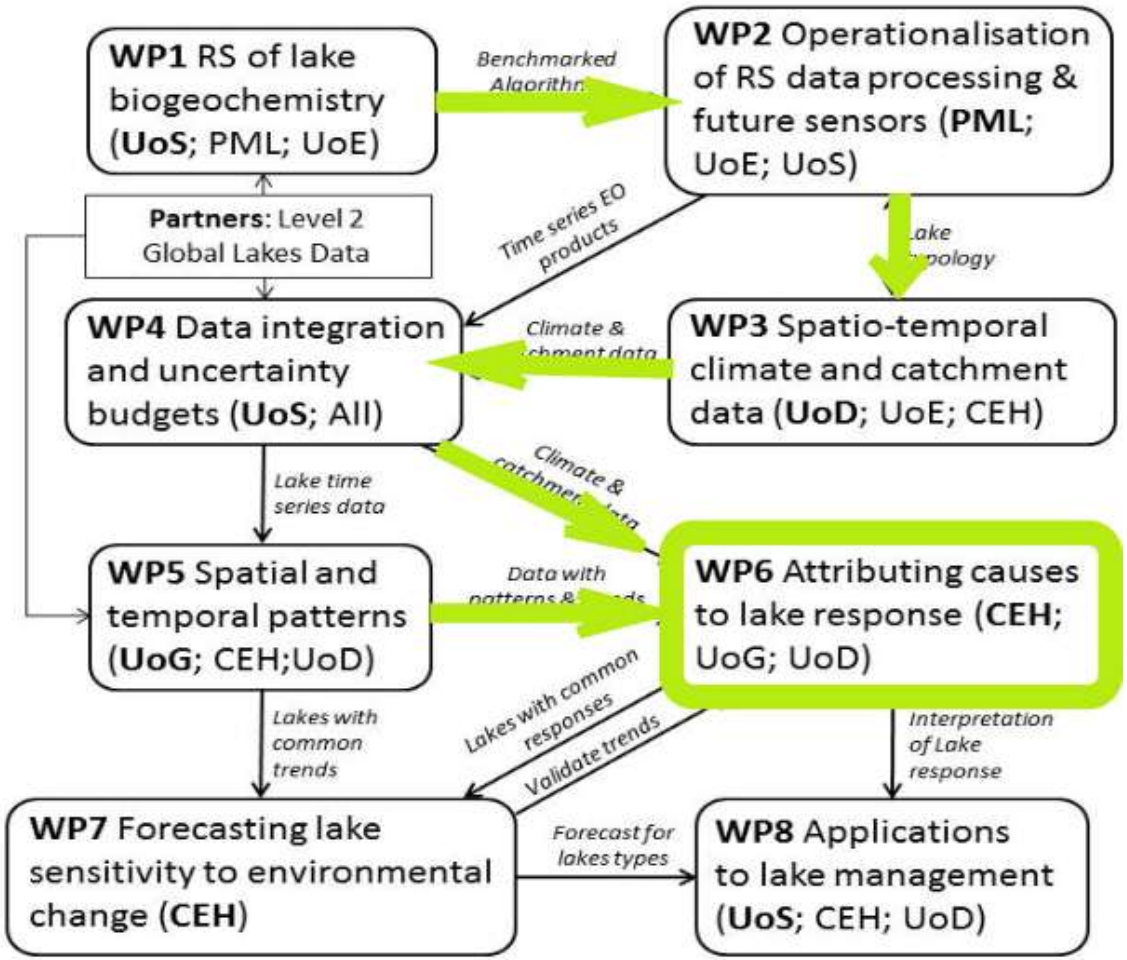
Strong collaboration with Universities of Glasgow and Dundee

# WP6 within GloboLakes

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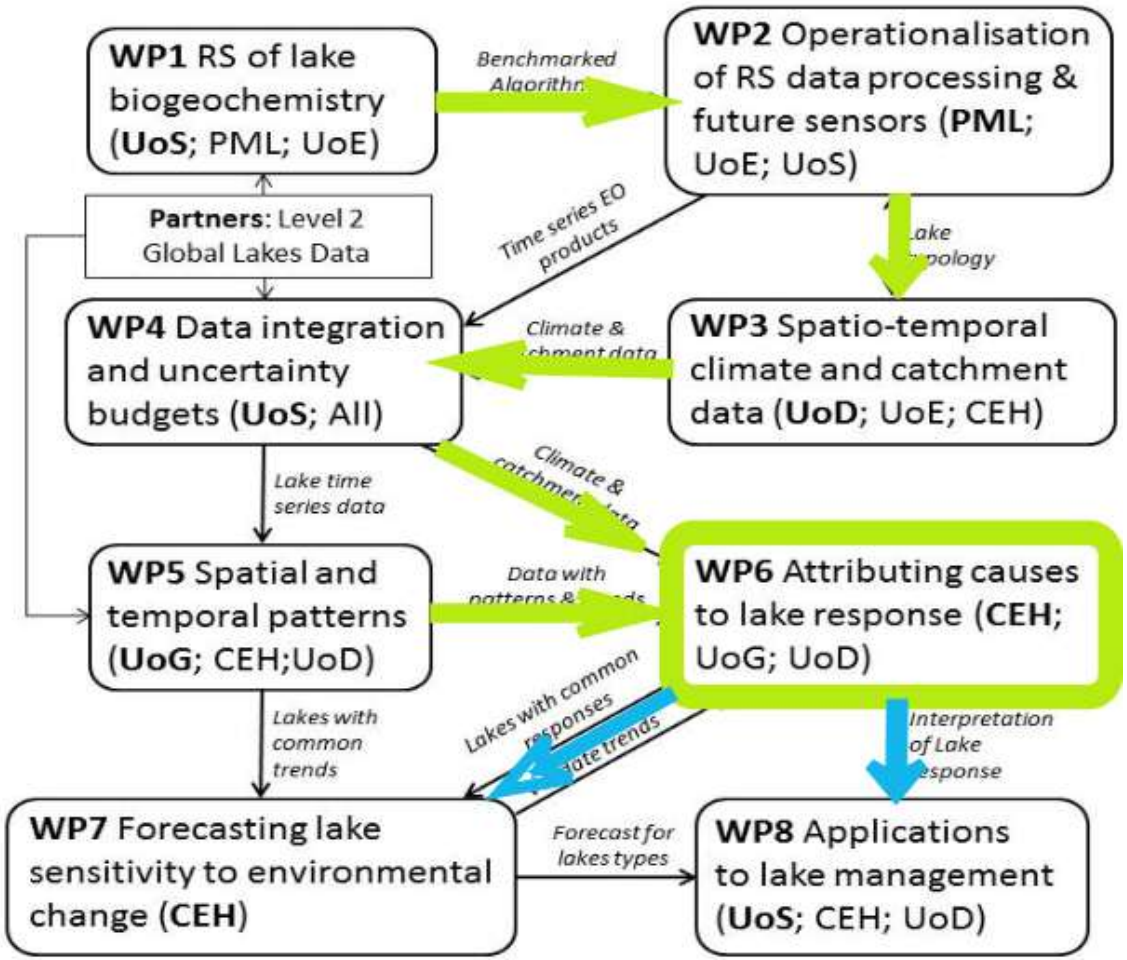
# WP6 within GloboLakes

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# Timing

**Gantt Chart**

| WP | Tasks | YEAR 1 | | | | YEAR 2 | | | | YEAR 3 | | | | YEAR 4 | | | | YEAR 5 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | month of project activities | 1 - 2 - 3 | 4 - 5 - 6 | 7 - 8 - 9 | 10 - 11 - 12 | 1 - 2 - 3 | 4 - 5 - 6 | 7 - 8 - 9 | 10 - 11 - 12 | 1 - 2 - 3 | 4 - 5 - 6 | 7 - 8 - 9 | 10 - 11 - 12 | 1 - 2 - 3 | 4 - 5 - 6 | 7 - 8 - 9 | 10 - 11 - 12 | 1 - 2 - 3 | 4 - 5 - 6 | 7 - 8 - 9 | 10 - 11 - 12 |
| **WP1** | **RS Algorithm Development** | | | | | | | | | | | | | | | | | | | | |
| D1.1 | Space-time variability in lake optical properties | | | | | | | | D1.1 | | | | | | | | | | | | |
| D1.2 | Intercomparison and benchmarking of algorithms | | | | | | | | D1.2 | | D1.2 | | | | | | | | | | |
| D1.3 | Ensemble algorithm for global scale operation | | | | | | | | | | D1.3 | | | | | | | | | | |
| D1.4 | Extend ARC-Lakes LSWT data set | | | | | | | | D1.4 | | | | | | | | | | | | |
| **WP2** | **Algorithm Operationalisation** | | | | | | | | | | | | | | | | | | | | |
| D2.1 | Automated data processing Chain | | | | | | | | | | | D2.1 | | | | | | | | | |
| D2.2 | Consistent MERIS and Sentinel 3 data sets | | | | | | | | | | | | | | | | D2.2 | | | | |
| D2.3 | Operational Global Lakes Observatory | | | | | | | | | | | | | D2.4 | | | | | | | |
| D2.4 | Archived Data dissemination | | | | | | | | | | | | | | | | | | | | D2.4 |
| D2.5 | LSWT time series 1991-2007 | | | | | | | | | | | | | | | | | | | | D2.5 |
| **WP3** | **Climatic & Nonoclimatic Drivers** | | | | | | | | | | | | | | | | | | | | |
| D3.1 | Selection of sentinel lakes | D3.1 | | | | | | | | | | | | | | | | | | | |
| D3.2 | Datasets of long term trends in climatic variables | | | D3.2 | | | | | | | | | | | | | | | | | |
| D3.3 | Characterisation of landcover/land use trends | | | | | | | | | D3.3 | | | | | | | | | | | |
| D3.4 | Modelling run off, sediment & nutrient inflow | | | | | | | | | | | | D3.4 | | | | | | | | |
| D3.5 | Hydromorphological alteration assessment | | | | | | | D3.5 | | | | | | | | | | | | | |
| **WP4** | **Data Integration & Uncertainty Budgets** | | | | | | | | | | | | | | | | | | | | |
| D4.1 | QA'd intercomparable and documented datasets | | | | | | | | D4.1 | | | | D4.1 | | | | | | | | |
| D4.2 | Measures of uncertainty on lake observations | | | | | | | | D4.2 | | | | | | | | | | | | |
| D4.3 | Uncertainties with catchmen and climate drivers | | D4.3 | | | | | | D4.3 | | D4.3 | | D4.3 | | | | | | | | |
| D4.4 | Measures of uncertainty on EO products | | | | | | | | | | | | D4.4 | | | | | | | | |
| **WP5** | **Detecting Spatial and Temporal Patterns** | | | | | | | | | | | | | | | | | | | | |
| D5.1 | Inventory of lake condition > 1000 global lakes | | | | | | | | | | | | D5.1 | | | | | | | | |
| D5.2 | Indentification of long term patterns of change | | | | | | | | | | | | | | | | | D5.2 | | | |
| D5.3 | Identification of clusters of common signals | | | | | | | | | | | | | | | | | D5.5 | | | |
| D5.4 | Identification of non conforming lakes | | | | | | | | | | | | | | | | | D5.6 | | | |
| **WP 6** | **Attributing Causes of Lake Response** | | | | | | | | | | | | | | | | | | | | |
| D6.1 | Causes of coherence for different senssed lakes characteristics | | | | | | | | | | | | | | | | | | | | D6.1 |
| D6.2 | Causes of phenological change | | | | | | | | | | | | | | | | | | | | D6.2 |
| D6.3 | Factors controlling cyanobacterial blooms | | | | | | | | | | | | | | | | | | | | D6.3 |
| D6.4 | Assessment of factors controlling CDOM | | | | | | | | | | | | | | | | | | | | D6.4 |
| **WP 7** | **Interpretation and forecasting Lake sensitivity** | | | | | | | | | | | | | | | | | | | | |
| D7.1 | The identification of lake types vulnerable | | | | | | | | | | | | | | | | | | | | D7.1 |
| D7.2 | Cyanobactria risk under a range of scenarios | | | | | | | | | | | | | | | | | | | | D7.2 |
| **WP 8** | **Apply Data for Lake Management** | | | | | | | | | | | | | | | | | | | | |
| D8.1 | Stakeholder requirements and research capabilities | D8.1 | | | | | | D8.1 | | | | | D8.1 | | | | | | | | D8.1 |
| D8.2 | UK wide understanding of change in lake condition | D8.2 | | | | | | D8.2 | | | | | D8.2 | | | | | | | | D8.2 |
| D8.3 | Future threats to lakes at a global scale | | | | | | | | | | | | | | | | | | | | D8.3 |
| D8.4 | A sustainable future for Globolakes | | | | | | | | | | | | | | | | | | | | D8.4 |
| **Project Meetings (T = Teleconference; M = meeting)** | | | | | | | | | | | | | | | | | | | | | |
| | GloboLakes Team) | M | T | T | T | M | T | T | T | M | T | T | M | | T | T | T | M | T | T | M |
| | Project Advisory Board | M | | | | M | | | | T | | | M | | | | | T | | | M |
| **Dissemination of Outputs** | | | | | | | | | | | | | | | | | | | | | |
| DO.1 | Project Web Site | DO.1 | | | | | | | | | | | | | | | | | | | |
| DO.2 | News Letters | DO.2 | | | | DO.2 | | | | DO.2 | | | | DO.2 | | | | DO.2 | | | DO.2 |
| DO.3 | Publications | | | | | | | | | | | | | | | | | | | | |
| **Impact Plan** | | | | | | | | | | | | | | | | | | | | | |
| DI.1 | Project launch | DI.1 | | | | | | | | | | | | | | | | | | | |
| DI.2 | End User Workshops | DI.2 | | | | | | | | | | | DI.2 | | | | | | | | DI.2 |
| DI.3 | Partners Workshop Calibration | DI.3 | | | | | | | DI.3 | | | | DI.3 | | | | | | | | DI.3 |
| DI.3 | Partners Workshop Validation | | | | | | | | | | | | DI.4 | | | | DI.4 | | | | DI.4 |
| DI.4 | Secondments | | | | DI.5 | | | | | DI.5 | | | | | | | | DI.5 | | | |

KEY — Workpackage effort — D1.1 Timing of individual components and month of deliverable, i.e. D1 (e.g. start, mid or end quarter)

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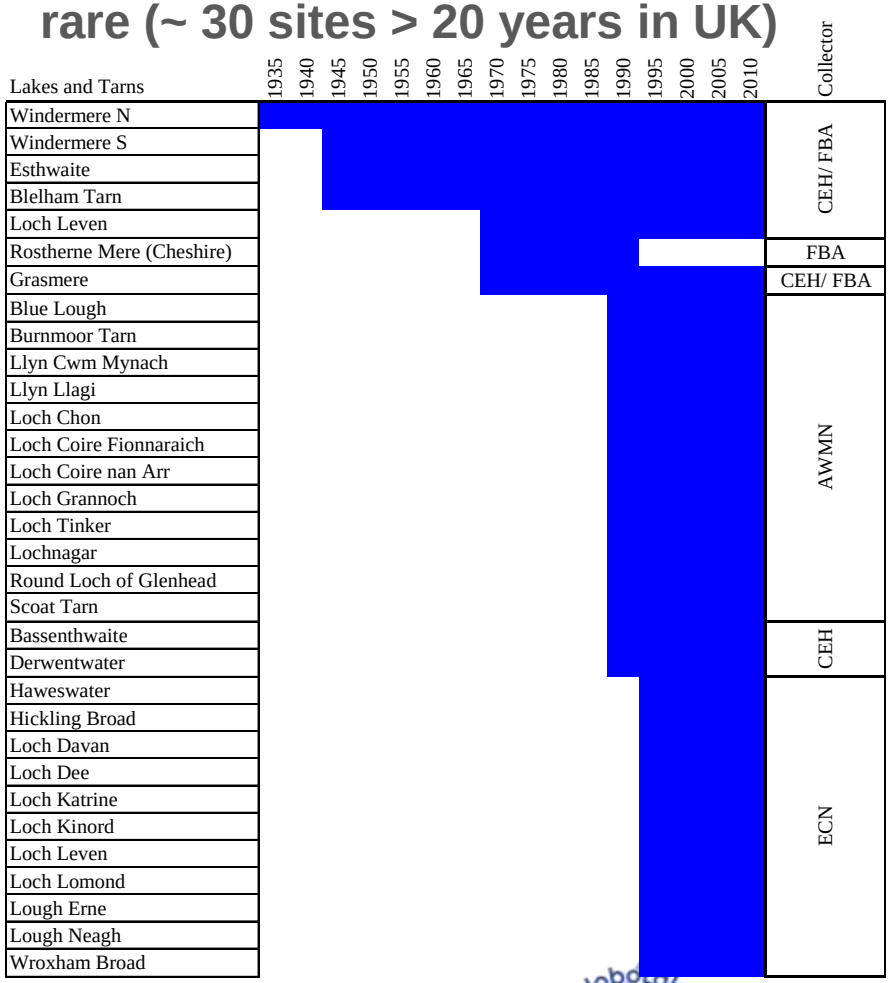
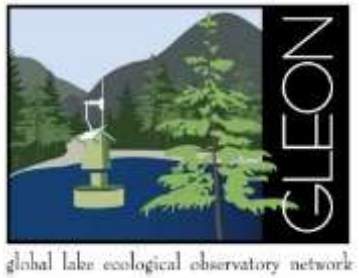
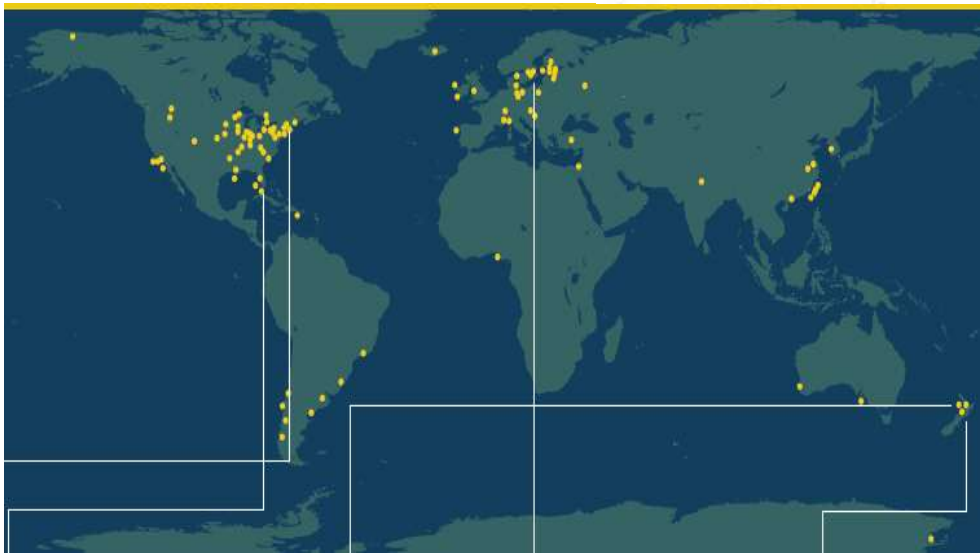
# Global lake datasets

## Long-term datasets on lakes are incredibly rare (~ 30 sites > 20 years in UK)




## Good lake datasets are also limited and comparisons across sites have issues of data comparability



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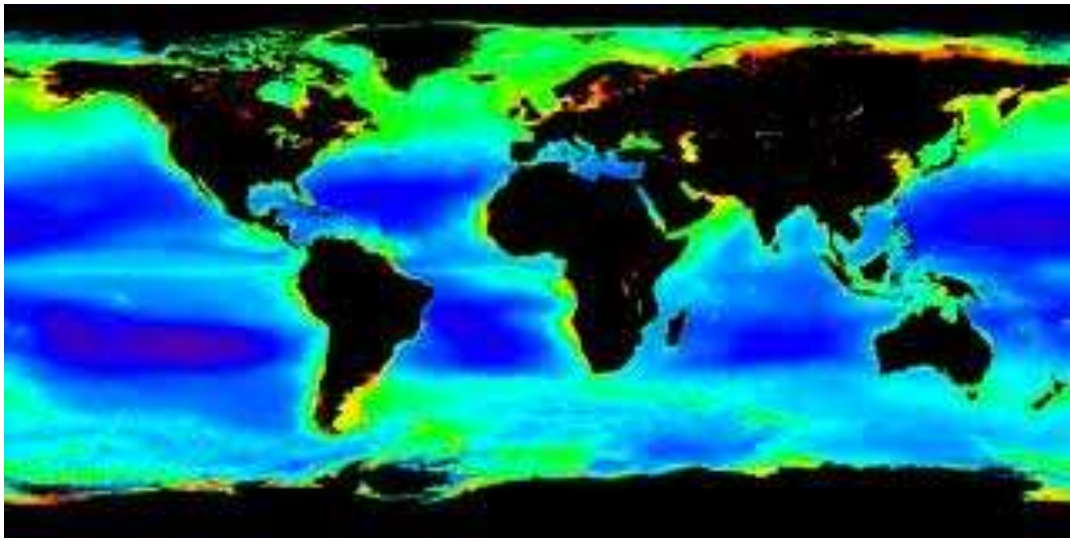
# GloboLakes' ambition

- ~1000 lakes across the world
- ~ monthly or better frequency
- ~15 years
- information on surface values for:
  - water temperature
  - chlorophyll a
  - phycocyanin
  - coloured DOM
  - total suspended solids
  - (primary production)



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# Objectives

6.1 Determine the causes of coherence for different sensed lake characteristics

6.2 Assess the causes of changing phenology

6.3 Assess the factors controlling cyanobacterial blooms

6.4 Assess the factors controlling coloured DOC


Land use change & deforestation

Water abstraction

Climate change

Invasion of non-native species

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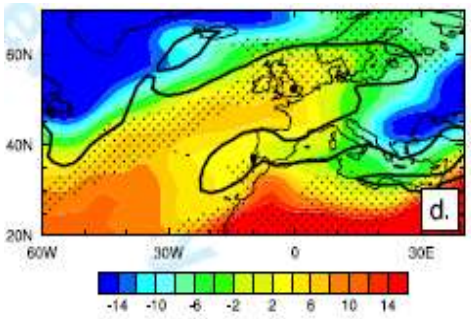
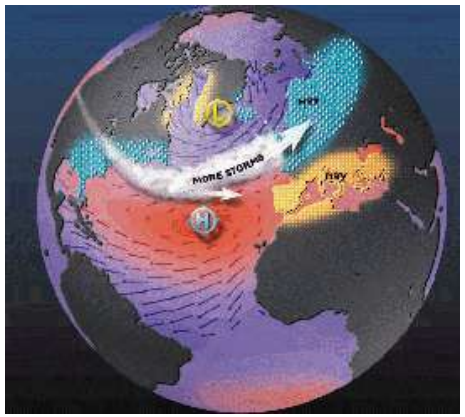
# 6.1 Determine the causes of coherence for different sensed lake characteristics

Rossby wave breaking at level of jet-stream

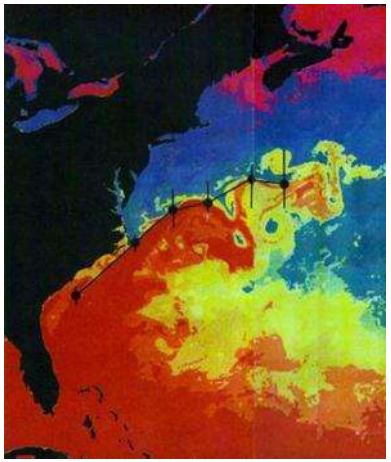



Strong & Maberly (2011) *Global Change Biol*.

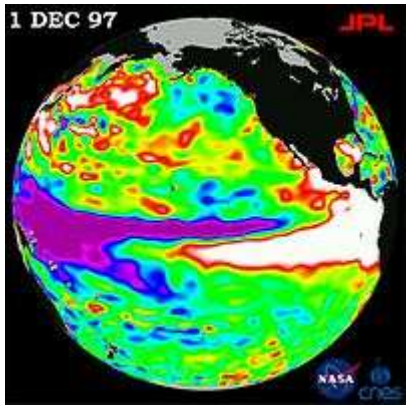
North Atlantic Oscillation



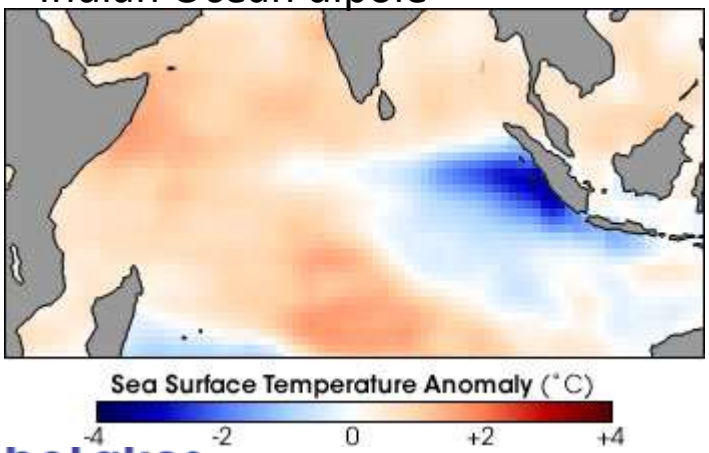

Position of Gulf Stream



ENSO




Indian Ocean dipole

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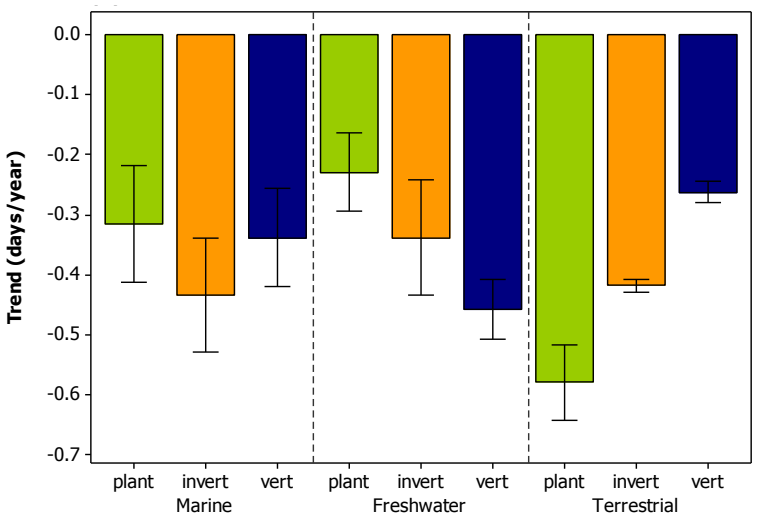
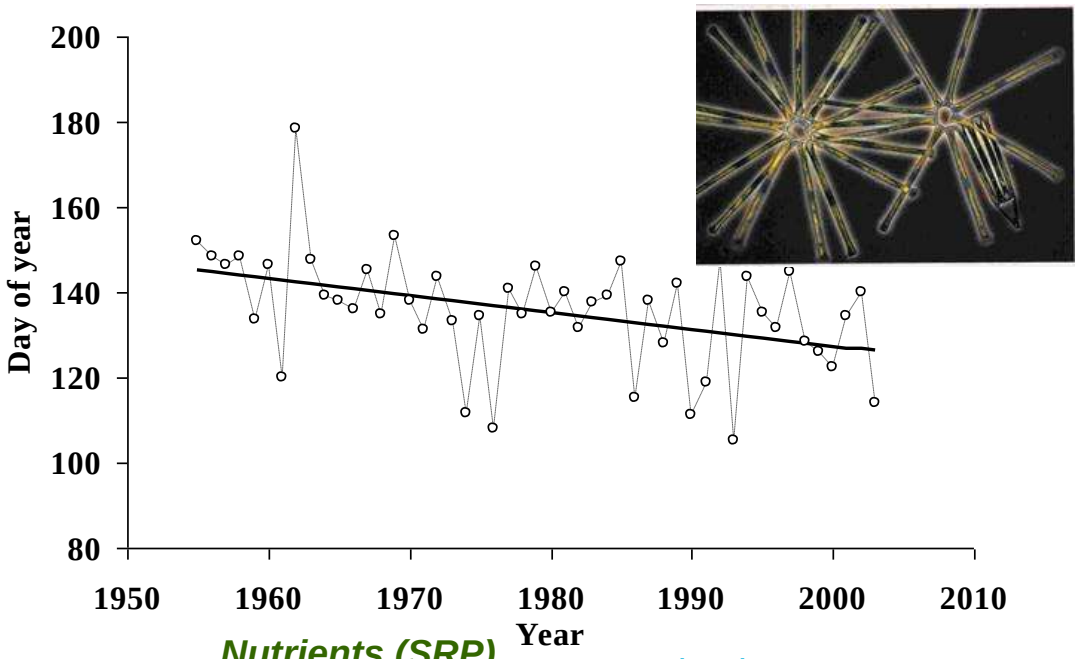
# 6.2 Assess the causes of changing phenology

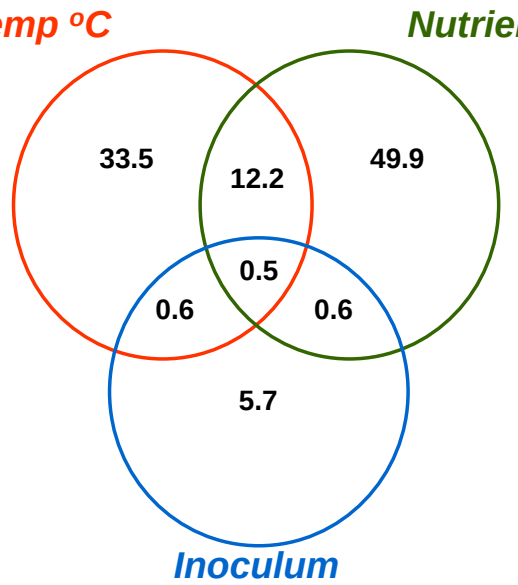



Plant
Invertebrate
Vertebrate

Thackeray *et al*. (2010) *Global Change Biol*.




Thackeray, Jones & Maberly (2008) *J. Ecol.*

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ial Change

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# 6.3 Assess the factors controlling cyanobacterial blooms

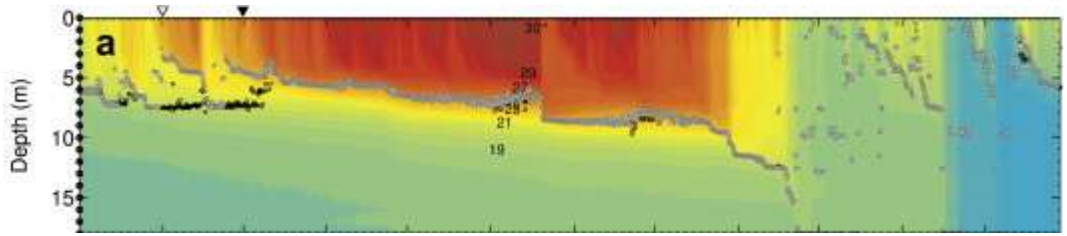
• Cyanobacterial blooms are a widespread response to local (nutrients) and global (climate) environmental change. Possible factors increasing their abundance include:

• Nutrient enrichment

• Low flows/drought

• High temperature


• Strong stratification

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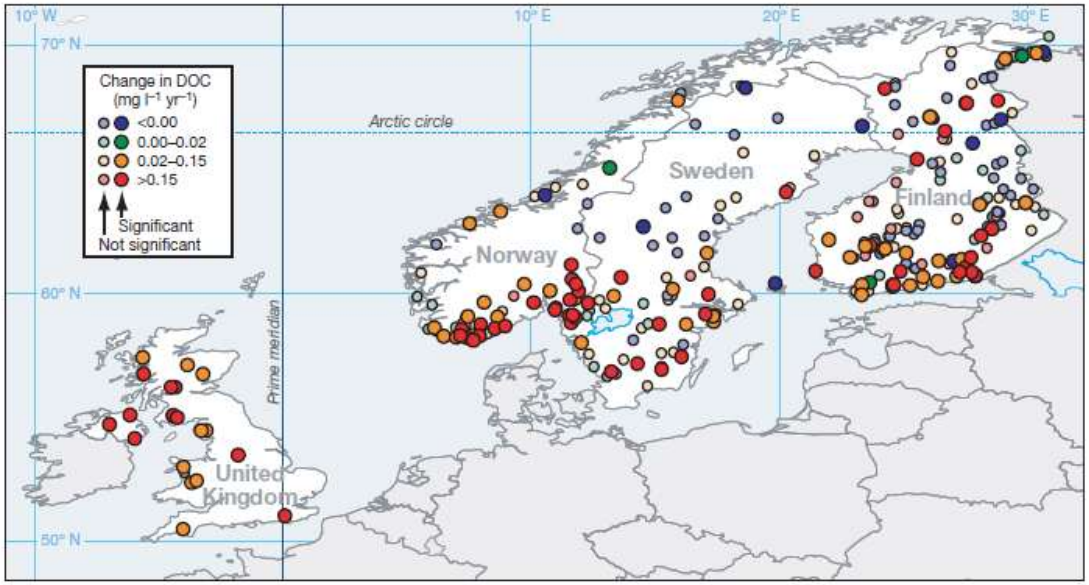
# 6.4 Assess the factors controlling coloured DOC




Monteith *et al*. (2007)
Nature

- Recovery from acidification (left)
- Nitrogen deposition
- Climate change
- Land-use change

# Conclusions

GloboLakes has the potential to produce a paradigm shift in our understanding of how lakes respond to environmental change at different scales and how this impacts on their status and function