University of Glasgow | School of Mathematics & Statistics

GloboLakes

WP5: Detecting spatial & temporal patterns

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WP5: Detecting spatial & temporal patterns

Aim:

To assess the extent of temporal coherence for individual remotely-sensed lake characteristics & to define the nature of any clusters of coherent lakes.

Contributors:

University of Glasgow
Centre for Ecology & Hydrology

Inputs: EO data products from WPs 1,2 and 3.

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Work Package 5

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Outputs: Temporal patterns and clusters of lakes for WPs 6 and 7

Temporal coherence

- The degree to which different lakes behave similarly through time.
- Understanding the spatial extent of coherence for different lake characteristics is a valuable tool to extrapolate from measured to unmeasured lakes.
- Access to 1000 long-term datasets will enable assessment of the degree of change in the coherence of seasonal patterns for lakes globally.

Objectives

5.1 Assess the present state & evidence for long-term change in the 1000 lakes.

5.2 Identify patterns of temporal coherence for individual remotely sensed lake characteristics & the spatial extent of coherence.

5.3 Identify phenological patterns of change in remotely sensed lake characteristics.

Implementation

June 2014 - September 2017

PDRA in Statistics at Glasgow University to be appointed from Sept 2013.

Develop and apply statistical models to the remotely sensed observations of lake characteristics to deliver temporal pattern analysis and spatial clustering.

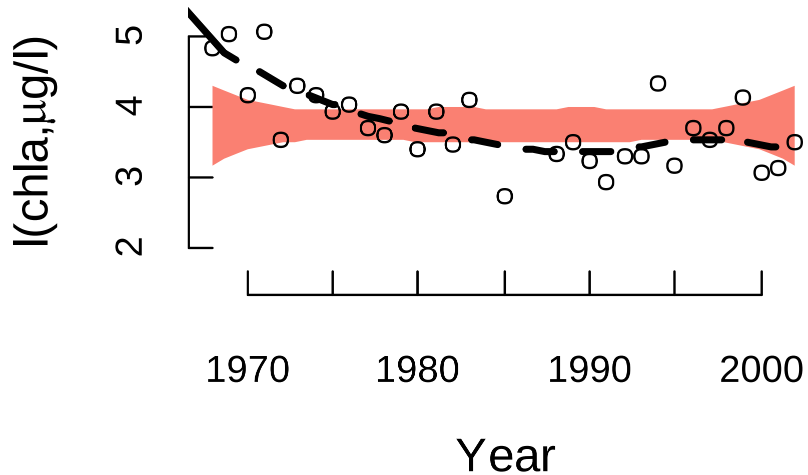
Here are some example analyses for each work package deliverable.

D5.1/5.2 Assess the present state & identify long-term patterns of change in global lakes.

Log chlorophyll at Loch Leven

Examples:

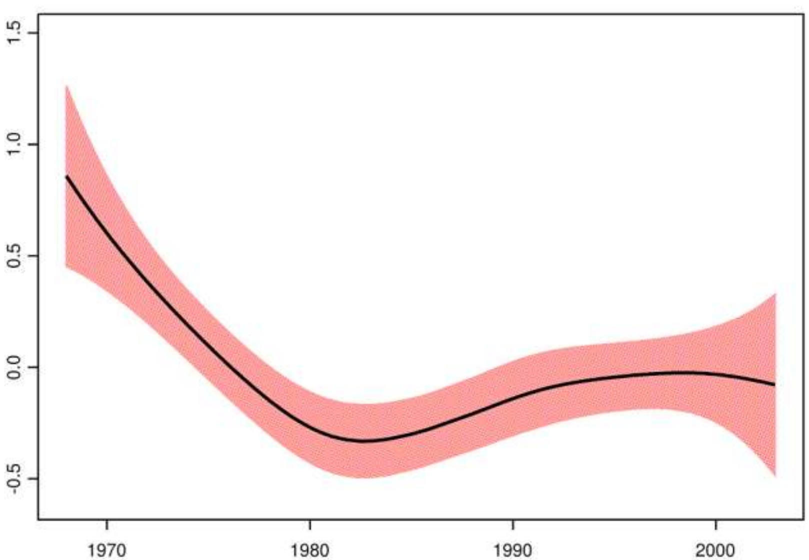
- Long-term trends for each season
- Long-term trend and seasonal patterns
- Changes in seasonality over time



Long-term trend in Spring log chlorophyll.

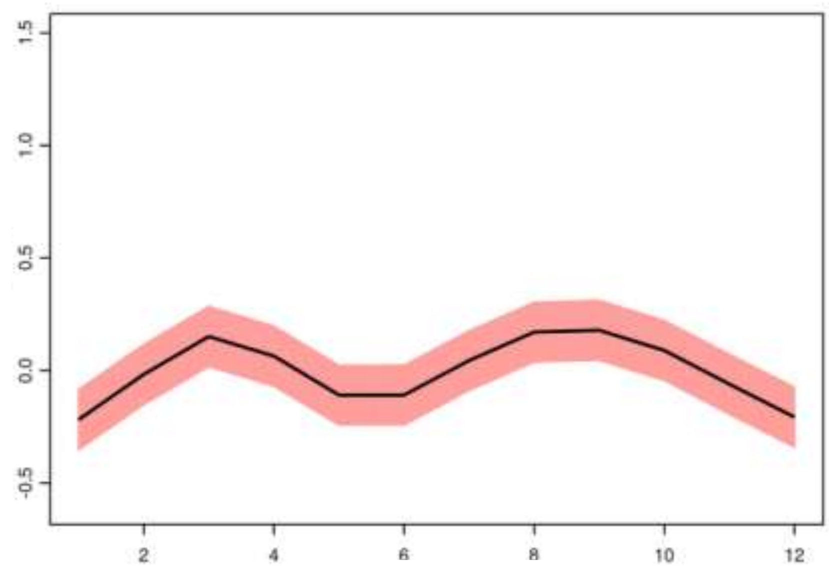
D5.1/5.2 Assess the present state & identify long-term patterns of change in global lakes.

Log chlorophyll, long-term trend with variability band



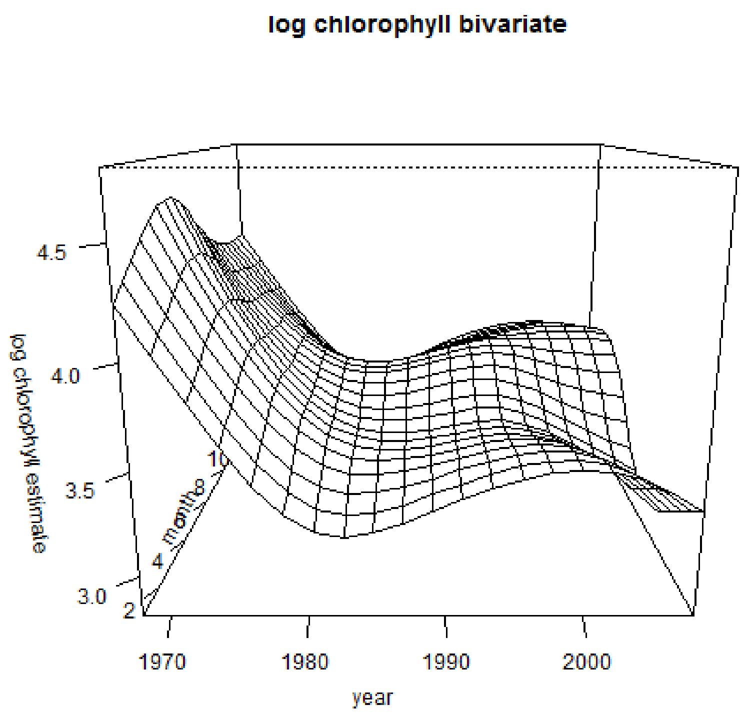
Year

Log chlorophyll, seasonal pattern with variability band

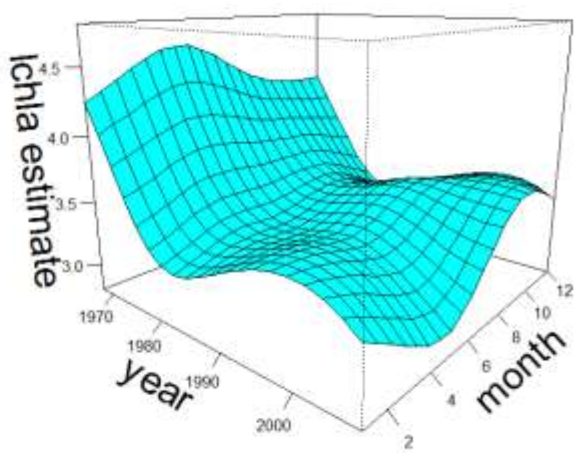


Month

Identify phenological patterns of change in remotely sensed lake characteristics.



log chlorophyll, Loch Leven

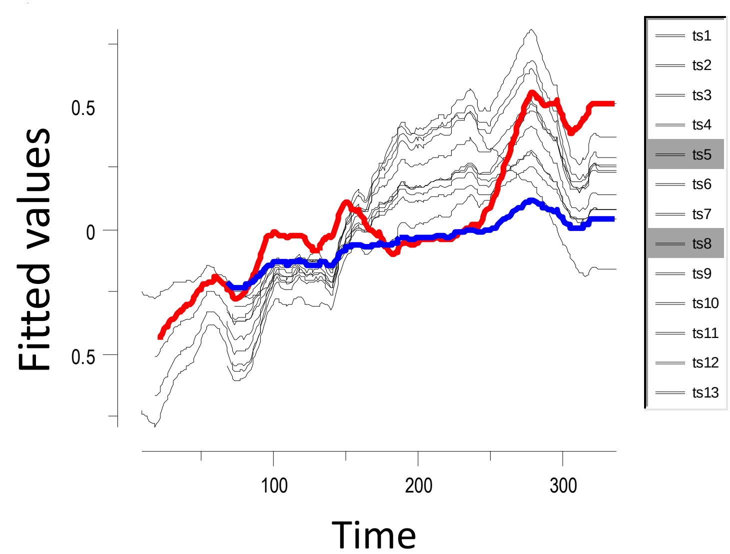


Ferguson et al. (2008), Carvalho et al. (2012)

D5.3/5.4 Identification of patterns of coherence, clusters of common signals and non-conforming lakes

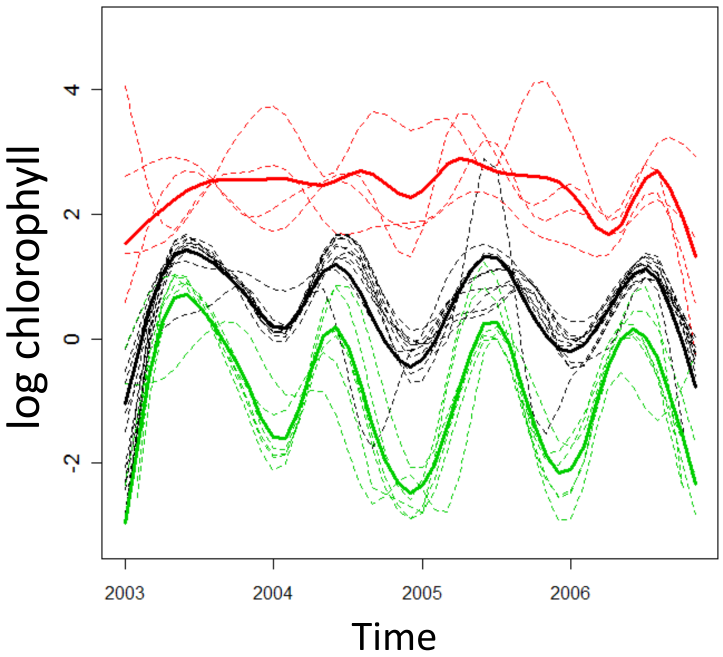
Statistical techniques include:

- Dynamic Factor Analysis
- Functional Data Analysis
- State space model for clustering, Finazzi et. al (2012)

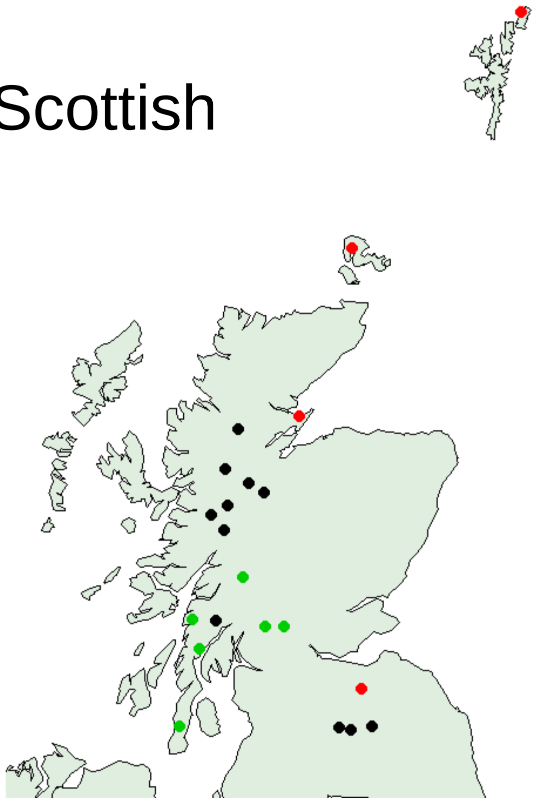


TOC fitted curves for 15 lake sites. Two common trends identified. Reid (2012)

D5.3/5.4 Identification of patterns of coherence, clusters of common signals and non conforming lakes



Clustering Scottish lakes using chlorophyll



Haggarty et. al (2012), Environmetrics

Work Package Challenges

- Obtaining an appropriate length of time series to enable identification of patterns of change.
- Data resolution – comparing different levels of spatial and temporal data.
- Computational challenges with modelling and clustering data from 1000 lakes.

References

Carvalho, L., Miller, C. , Spears, B.M., Gunn, I.D.M., Bennion, H., Kirika, A., and May, L. (2012) Water quality of Loch Leven: responses to enrichment, restoration and climate change. Hydrobiologia , 681 (1). pp. 35-47. ISSN 0018-8158 (doi: 10.1007/s10750-011-0923-x).

Ferguson, C.A. , Carvalho, L., Scott, E.M., Bowman, A.W. and Kirika, A. (2008) Assessing ecological responses to environmental change using statistical models. Journal of Applied Ecology , 45 (1). pp. 193-203. ISSN 0021-8901 (doi: 10.1111/j.1365-2664.2007.01428.x)

Haggarty, R,. Miller, C. Scott, E.M., Wyllie, F. and Smith M. (2012) Functional Clustering of Water Quality Data in Scotland, Environmetrics (Special Issue Paper) DOI: 10.1002/env.2185 (to appear).

Reid, Stephen James (2012) Trends of organic carbon in Scottish rivers and lochs. MSc(R) thesis, University of Glasgow.