

## **GLEON 9**

### **Domains of control/ Signal processing in aquatic ecosystems**

**Moderators:** Don Pierson, Eleanor Jennings

#### **Other group members**

Robin Smyth; Heidrun Feuchtmayr; Catherine O'Reilly; Alo Laas; James Rusak; Brenda Leroux; Susanna Scott; Susan Hendricks; Fang-Pang Lin.

#### **Sessions 1 and 2**

##### **The group was renamed:**

##### **New name**

Signal processing in aquatic ecosystems

##### **Mission statement**

Developing approaches to detect change and characteristic frequencies in GLEON monitoring data at differing regional and limnological scales

##### **Plan**

1. At this meeting: test datasets using the Excel add-in for the Rodianov shift detection method (detecting significant shifts in mean and variance)
2. ID other datasets that we want to work with – particularly biological, chlorophyll, DO,
3. Are there indices of lake mixing that we can work with?
4. We could look at when an ecological shift occurs in different datasets – zooplankton, fish? Are there characteristic frequencies?
5. Compare traditional sampling and high frequency monitoring?
6. Longer-term goal: Try to utilise s-scan data (e.g. now in three lakes in Northern Europe) = sub-surface spectrophotometers – range of absorption bands); need to develop methods first; also possibly deploy s:scan in other lake regions?

We want to encourage a student/s to join us who like add a chapter to their thesis and maybe get a publication out of this but who would time to give to data analyses.

## Session

### 1. Signal processing methods/system resilience as discussed yesterday

One way to approach this is to firstly have a student investigate the Rodionov spreadsheet e.g., what are appropriate parameter values?

Develop a best methodology using example datasets

Then perhaps recreate this algorithm in e.g. Matlab, Fortran

First need an understanding of the method – three or four representative datasets with differing levels of variability.

Of interest: statistical distribution of frequency of events; magnitude of events; how long to background?

Susanna will try out Rodionov method

Alo will do a review of other methods

We will tackle programming after this initial investigation

Brenda: which programme? Matlab, IDL, Fortran or R?

Brenda will see if there is anything similar already available in R.

### Suggested sites

Feeagh; YYL; Estwaite

### Available biology:

Estwaite has DO and BBE multiband fluorescence

YYL DO;

Feeagh: DO and fluorescence although the fluorescence still rare and sometimes noisy

**Time step?** Hourly averages –one years data

Jim: could also contrast with daily values

### 2. Fang Pang Lin:

FP has used system identification methods, common in e.g. engineering but not ecosystems

Need observed inputs and outputs

Can reconstruct the system (=approximate)

Parameters are obtained from observed data

Ideally he would like a set of e.g. **two years** data

This signal processing method is used in many ways in industry e.g. to predict behaviour of satellites

So this is a mature method

But lakes are complex

lake = a system; can then repeat the procedure for other lakes

Can be used to predict where systems will tend to fail

May or may not work for lakes

One lake a lot of inputs and response e.g. parameter chl a = output

So features captured – can use for prediction

Not confident that it will work;

Method ok but needs research

FP may also apply for funding in Taiwan maybe for postdoc; if we got funding, we could collaborate

Group will use the Domains of control list on GLEON webpage; people can add themselves on the GLEON website

Jim: how many variables?

FP: theoretically unlimited but will try e.g. 10

**Actions task 1:**

- EJ to ask Stuart about YYL and Elvira for Feeagh;
- Heidrun to supply Estwaite data to Suzanna
- Suzanna to apply Rodionov; procedure for investigation could be discussed in webspace;
- Alo to review other methods
- Brenda to look into R

**Actions task 2:**

- FP will get a note together and will put on web; use this as a starting point;
- FP will also put up some relevant publications
- EJ to set up Google webpage