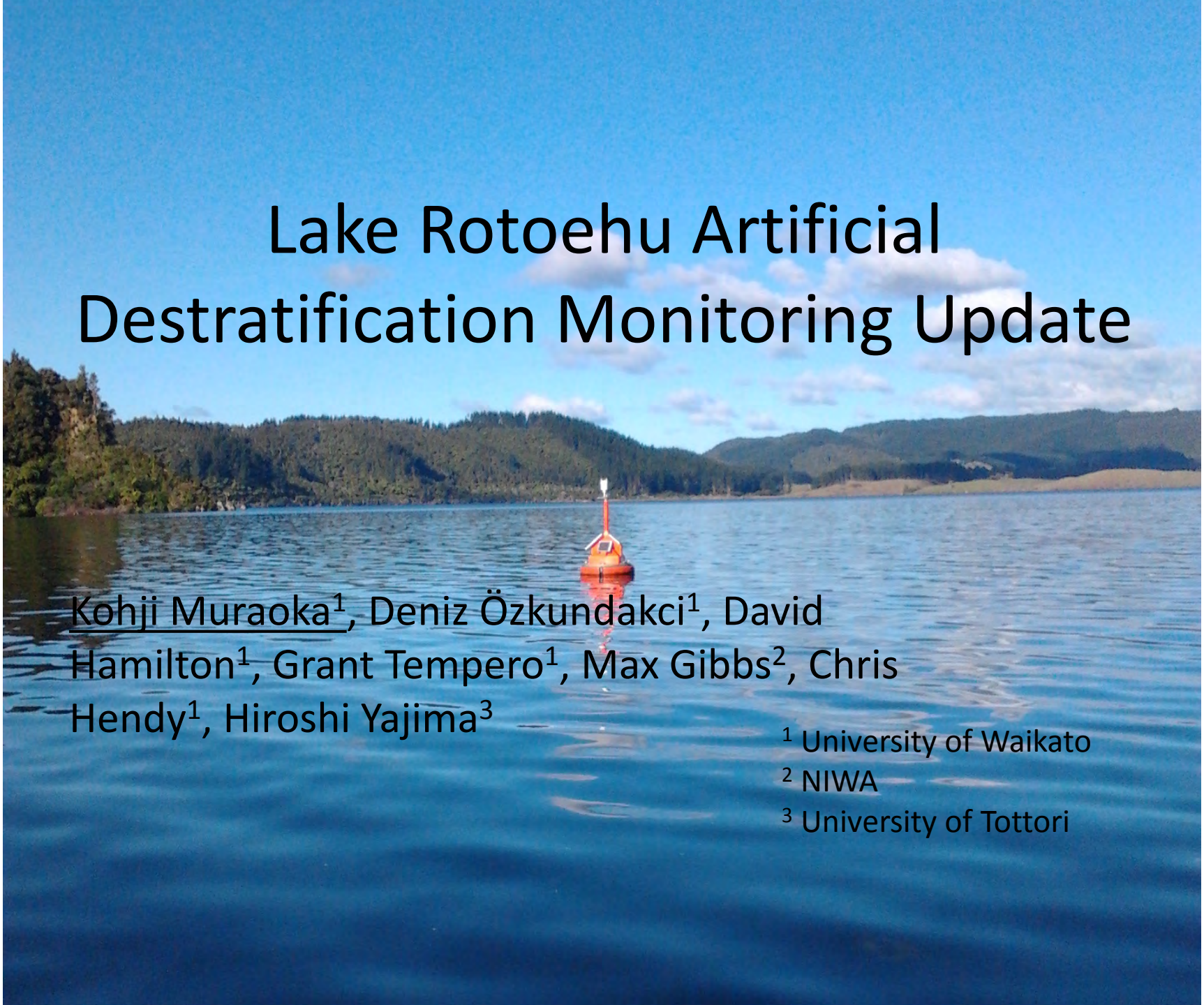


Lake Rotoehu Artificial Destratification Monitoring Update

Kohji Muraoka[1], Deniz Özkundakci[1], David Hamilton[1], Grant Tempero[1], Max Gibbs[2], Chris Hendy[1], Hiroshi Yajima[3]

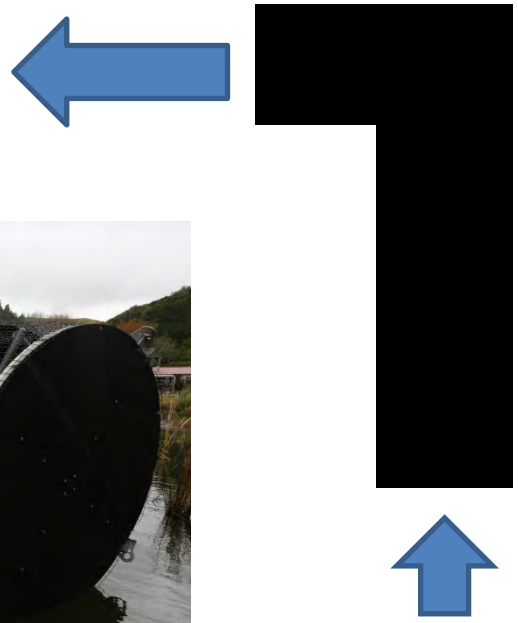
[1] University of Waikato
[2] NIWA
[3] University of Tottori

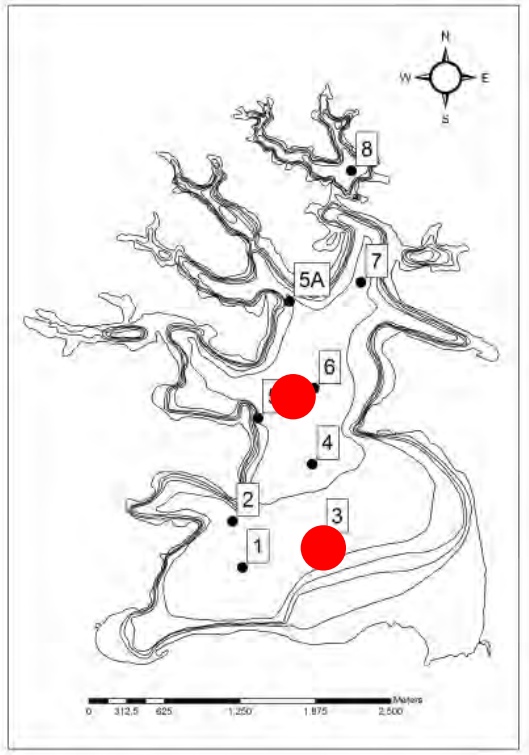
Agenda

- Sampling overview
- General Lake Trend since 2011
  - Secchi depth
  - Buoy data
  - Biofish
- Instrumented week
  - Satellite
  - Dye detection by biofish
  - Hiroshi’s flow meter results
  - Soda spring overview

Destratification device

Compressed air bubble creates upwelling water flow within vertical tubes





Monitoring summary

- Regular water quality monitoring - monthly
- Intense sampling - weekly to twice a week
- Instrumented week - flow assesment

Regular monitoring

Sites 1 | 2

Depth ~= 10m

Since Dec 2011

~~Intense sampling in 2013 Feb-Mar~~

0.5m & 9 m zooplankton

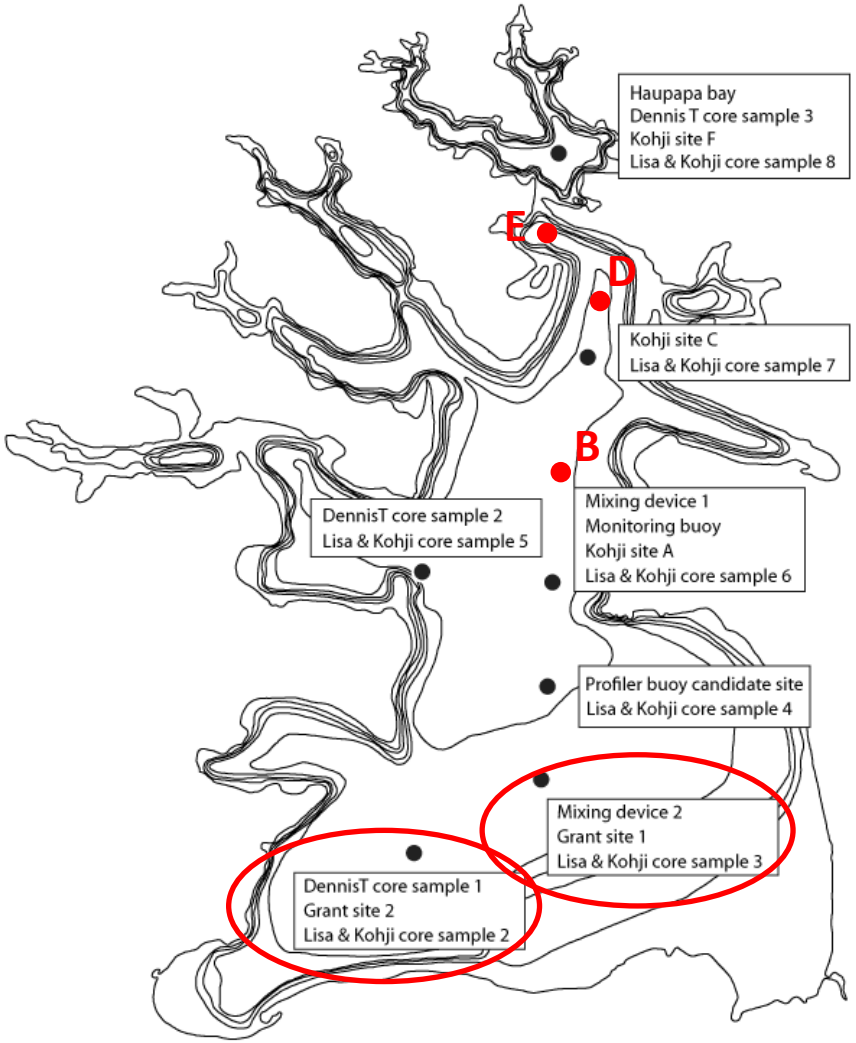
0.5m & 9 m phytoplankton

~~Depth integrated phytoplankton~~

Nutrient (dissolved/total)

CTD measurements (intense)

Secchi depth (intense)



Regular monitoring

Sites A | C | F

Depth ~= 10m

Since Mar 2012

Intense sampling in 2013 Feb-Mar

0.5m & 9 m zooplankton

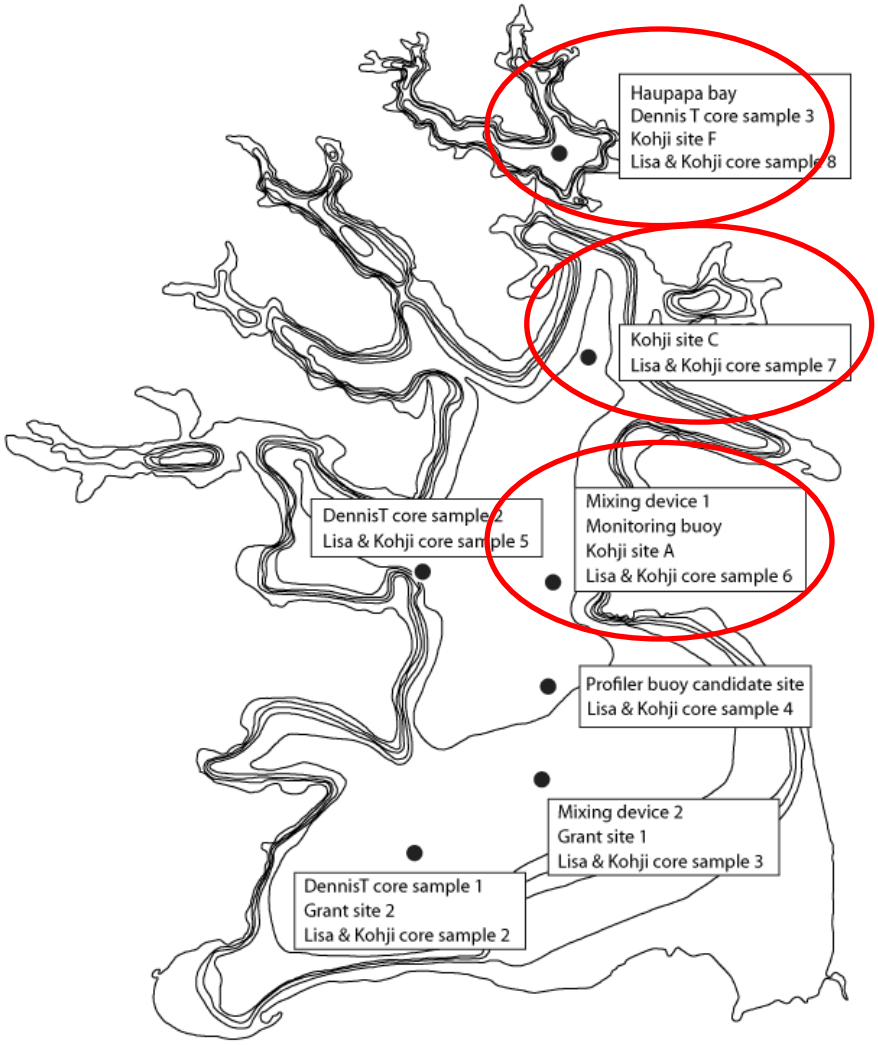
0.5m & 9 m phytoplankton

Depth integrated phytoplankton

Nutrient (dissolved/total)

CTD measurements

Secchi depth



Regular monitoring

Sites B | D | E

Depth ~= 10m

Since Feb 2012

Intense sampling in 2013 Feb-Mar

~~0.5m & 9 m zooplankton~~

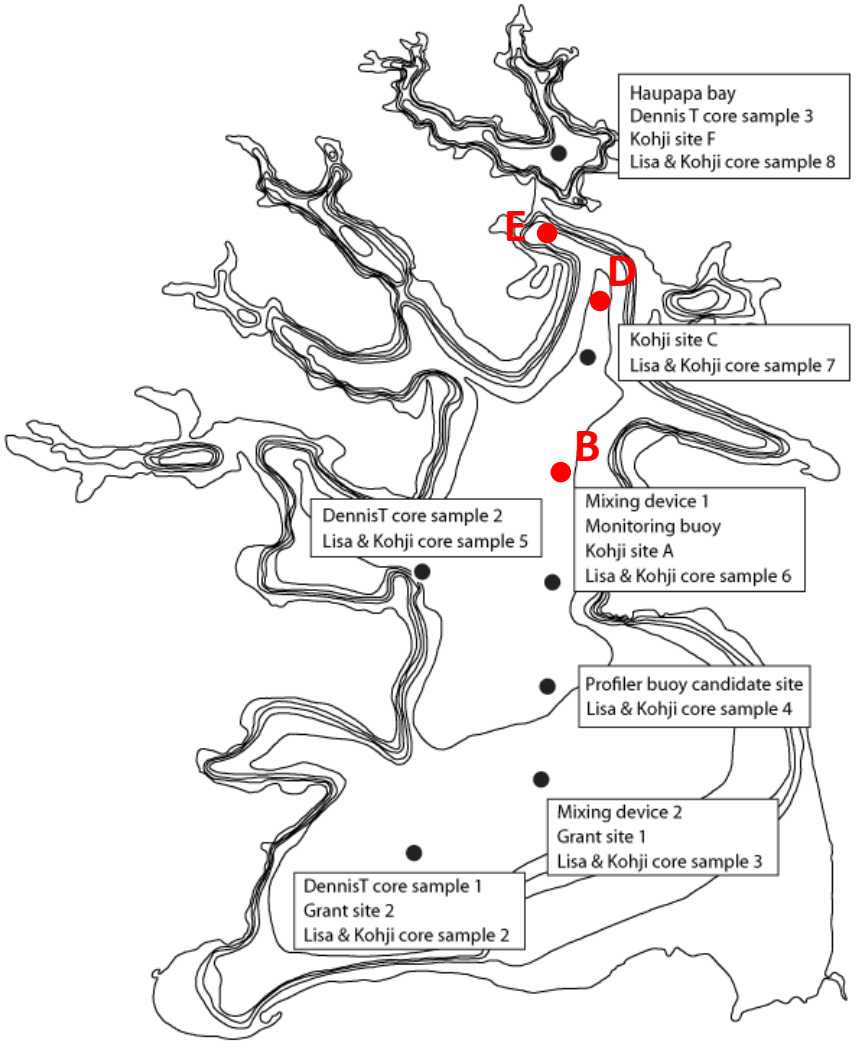
0.5m & 9 m phytoplankton

Depth integrated phytoplankton

Nutrient (dissolved/total)

CTD measurements

Secchi depth



Sediment core sampling

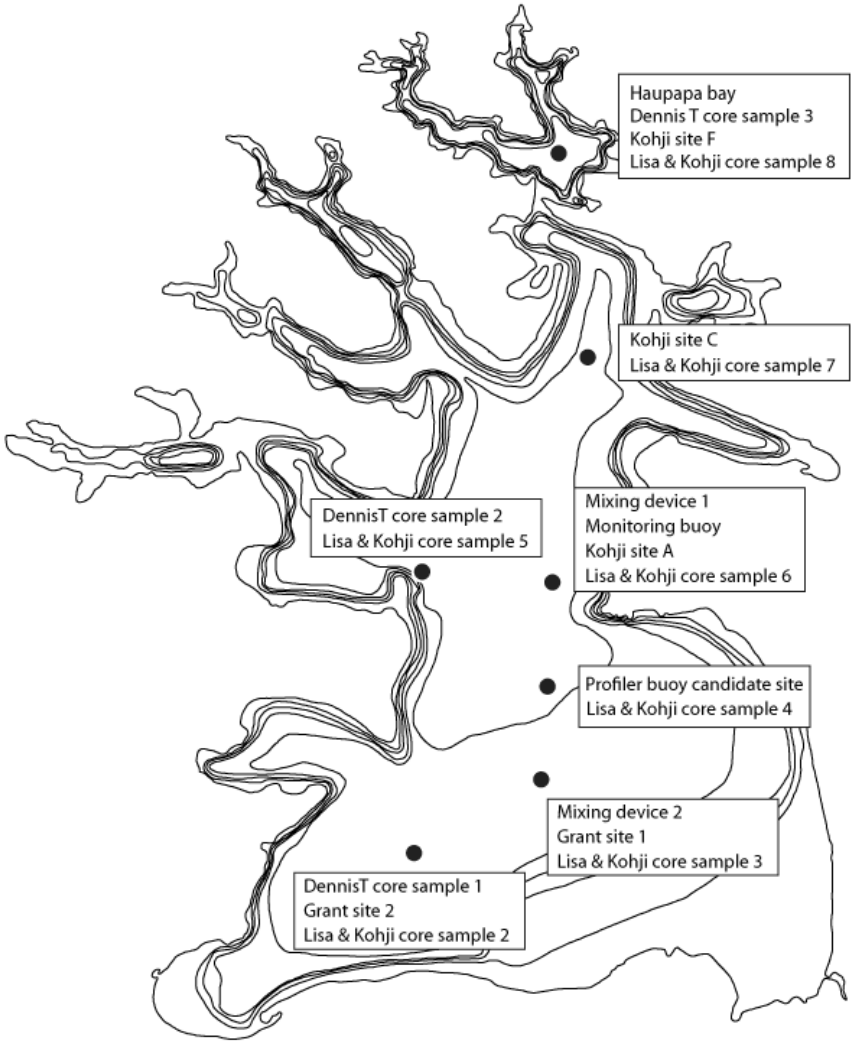
Core sites 1* – 8*

Depth ~= 10m

Jul 2011, Feb 2013

Sediment core sampling

Dennis T's sites included (1* & 5*)



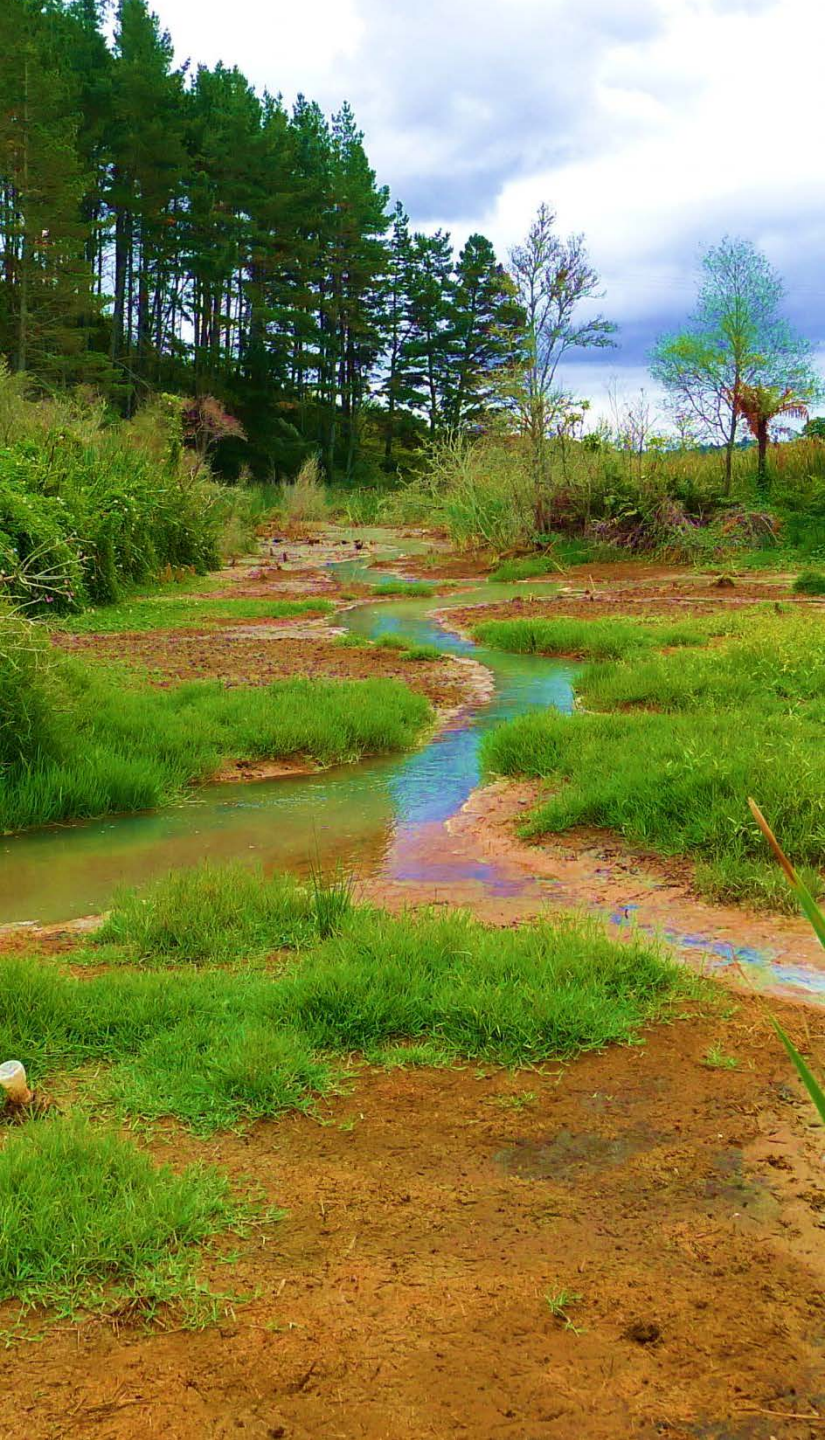
Intense monitoring

8th Feb 2013 – 21th Mar 2013

Sites A | B | C | D | E | F

2 times a week

For study of phytoplankton dynamics vs disturnance



Instrumented week

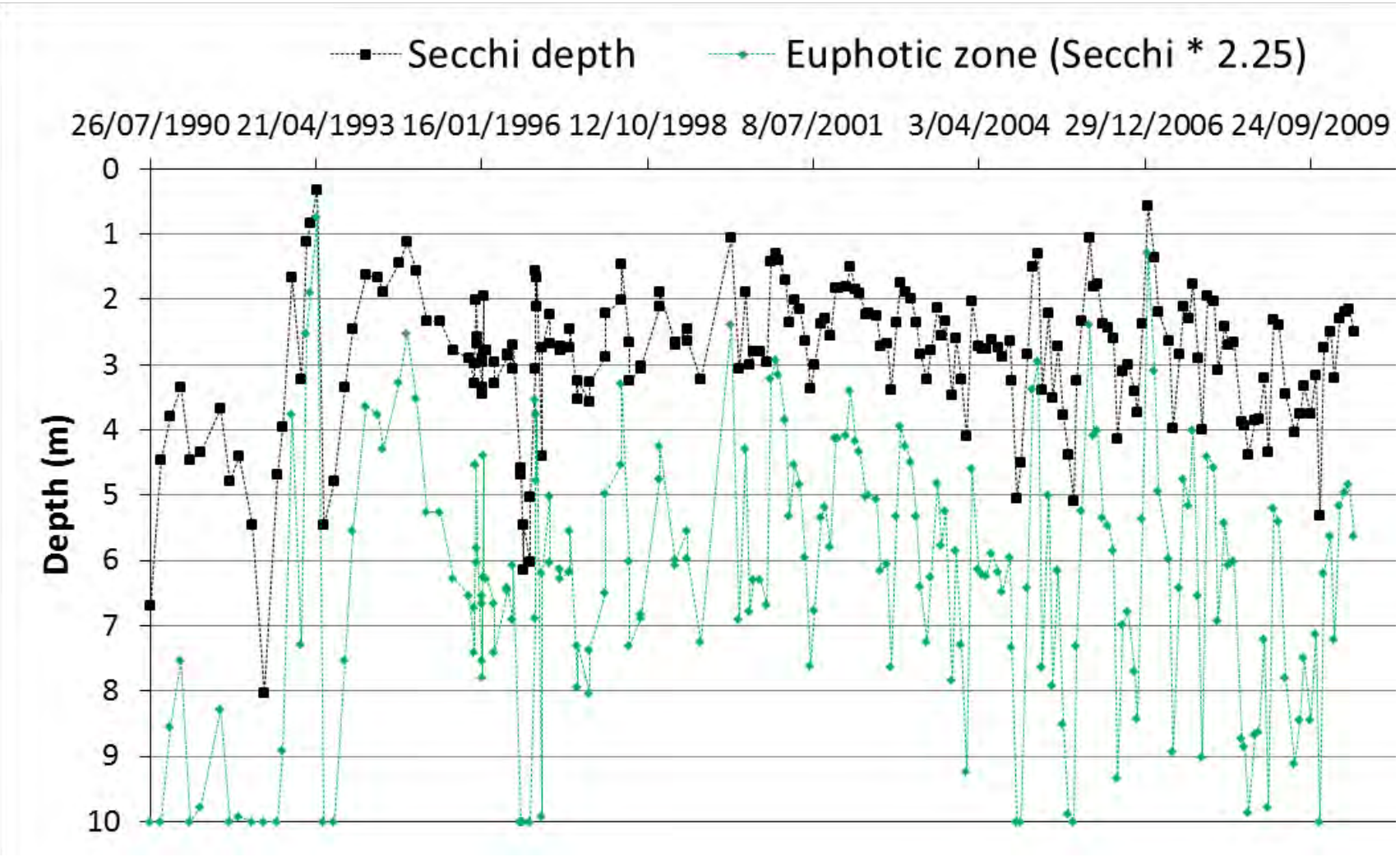
26th Feb 2013 – 1st Mar 2013

Instruments for study of hydrodynamics

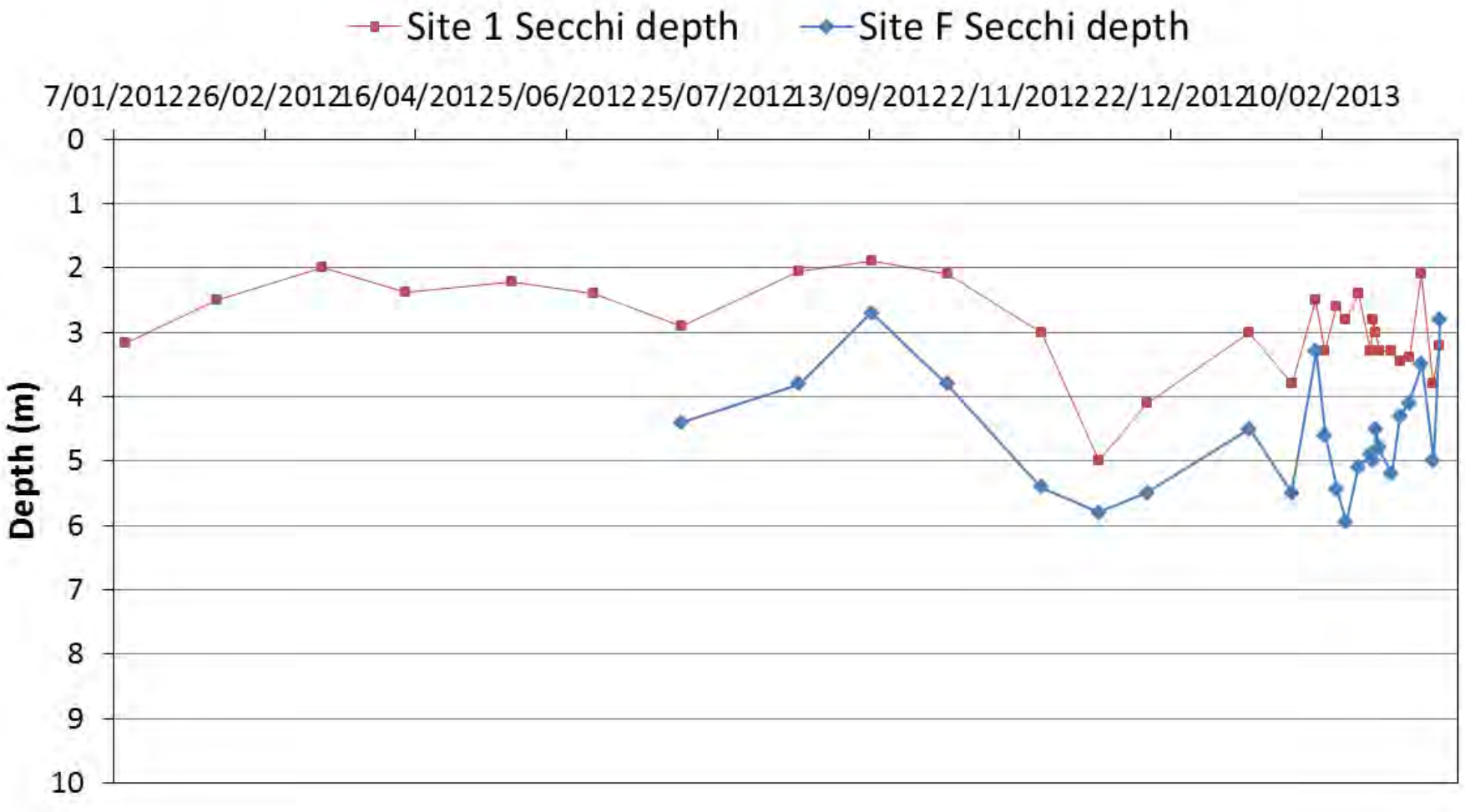
Dye release & detection | Satellite | ADCP (until 22nd March) | Flowmeters | NIWA ADCP boat flow detection | Instream survey | Everyday regular monitoring | Monitoring buoy | Additional buoy

Water clarity (Secchi disc)

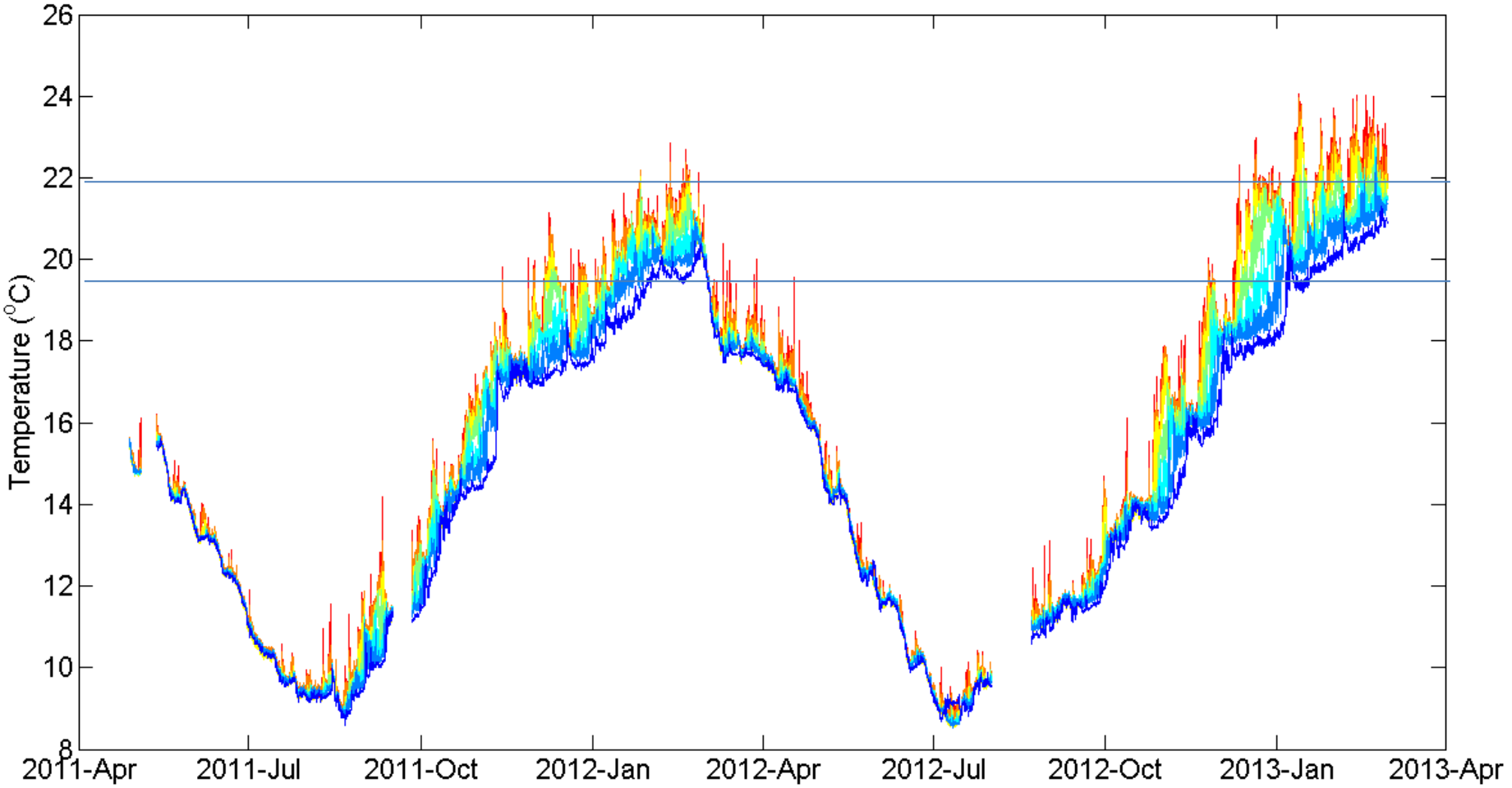
Water clarity (Secchi disc)



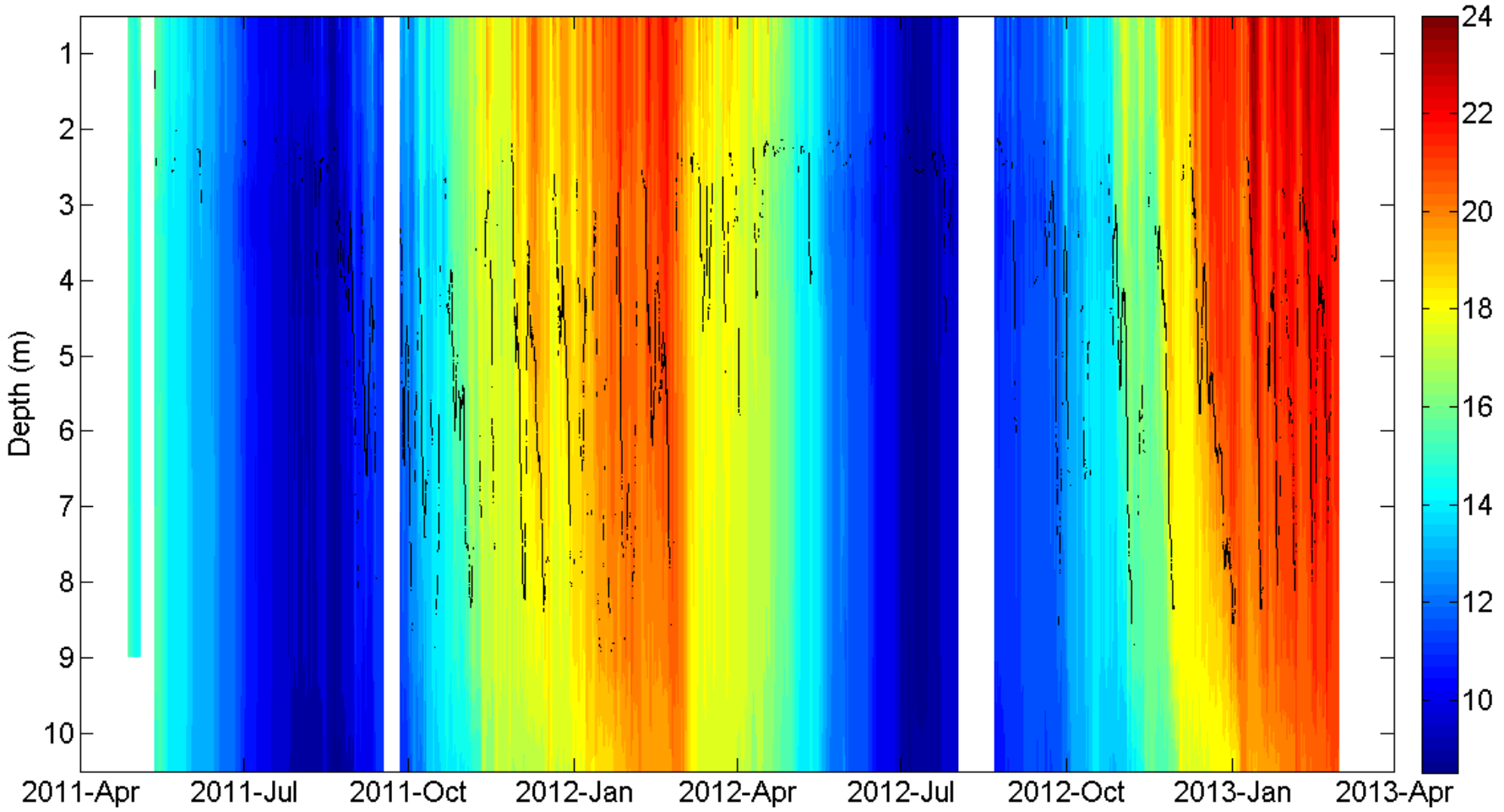
Water clarity (Secchi disc)



Temperature

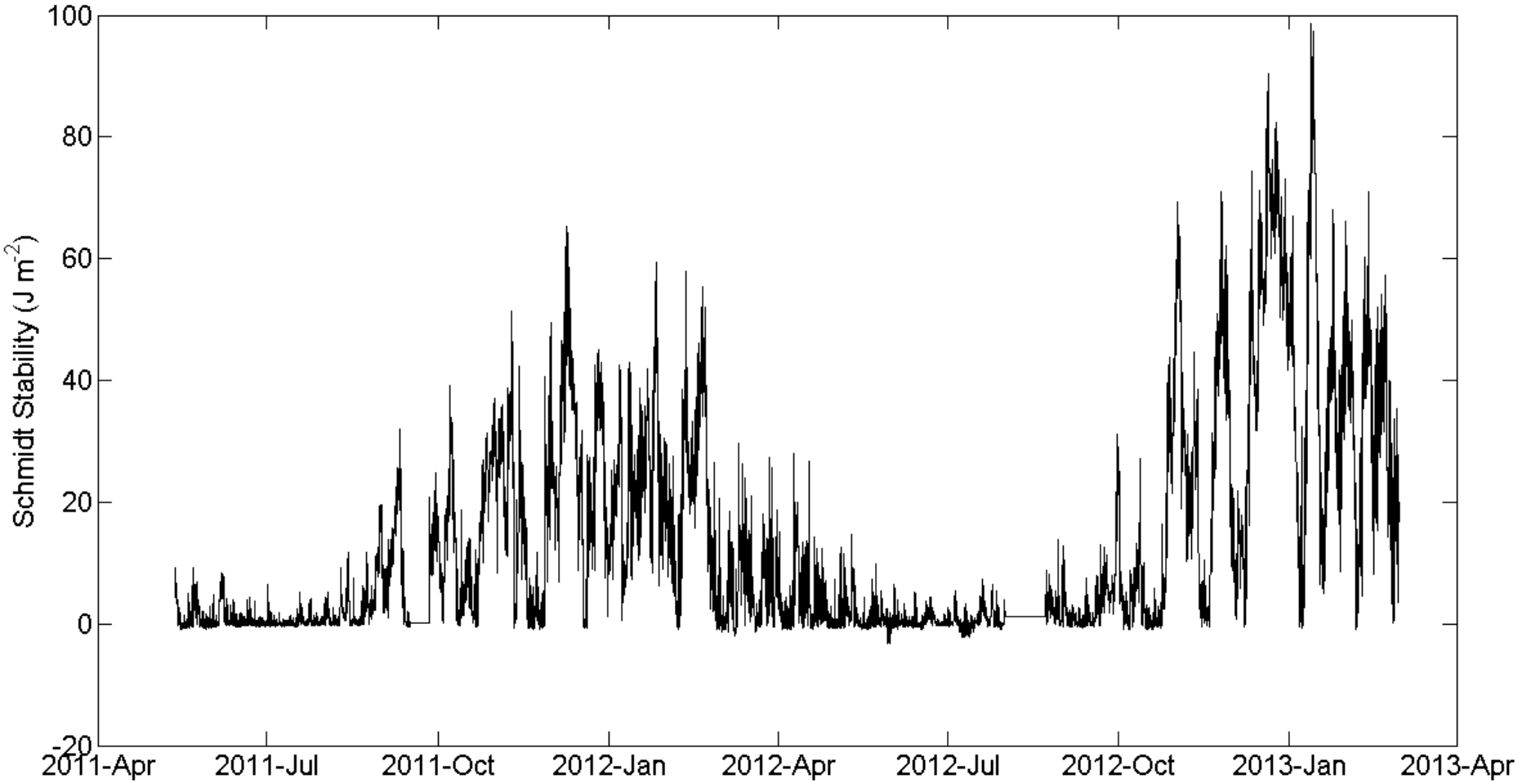


Temperature

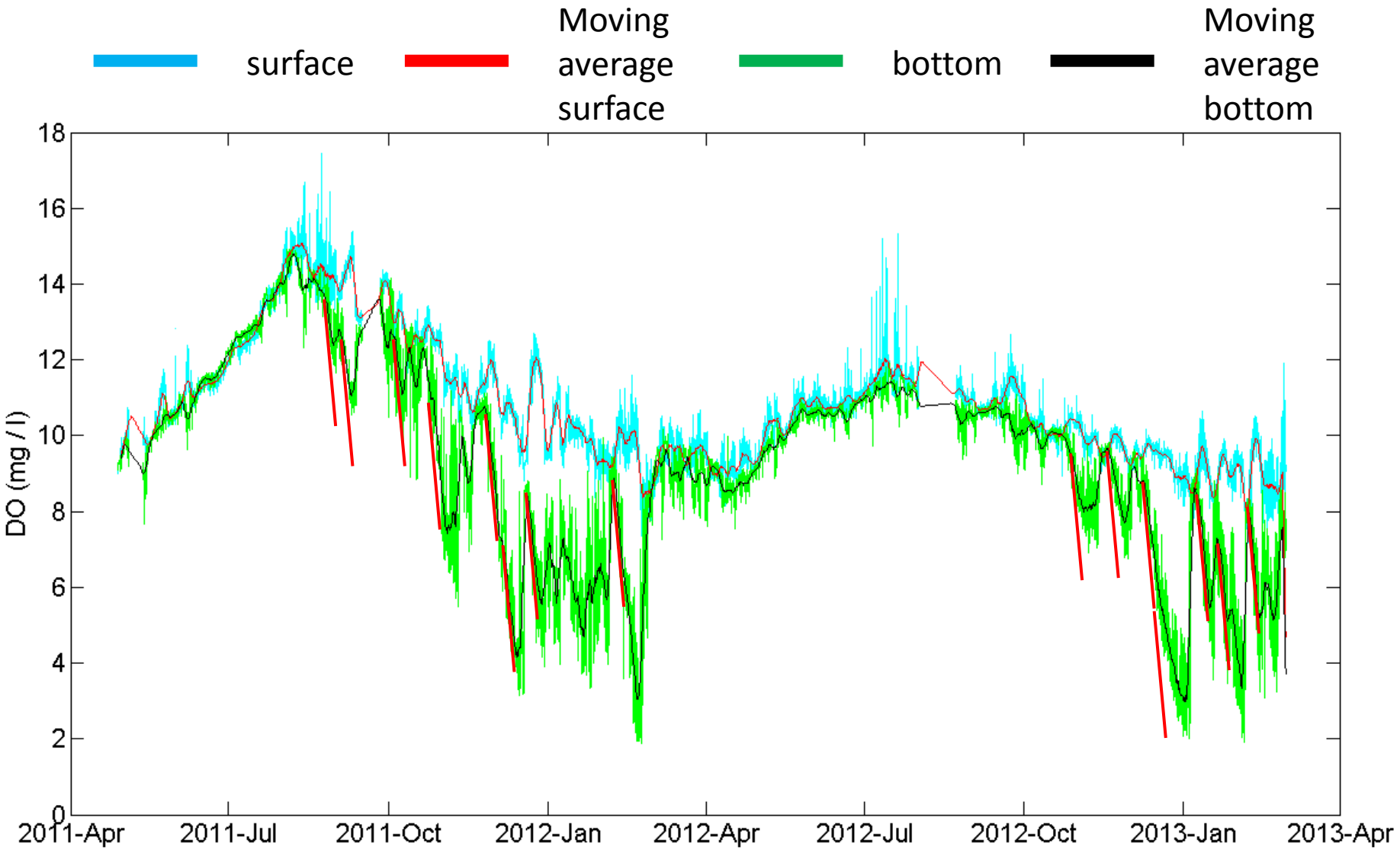


Thermal stability

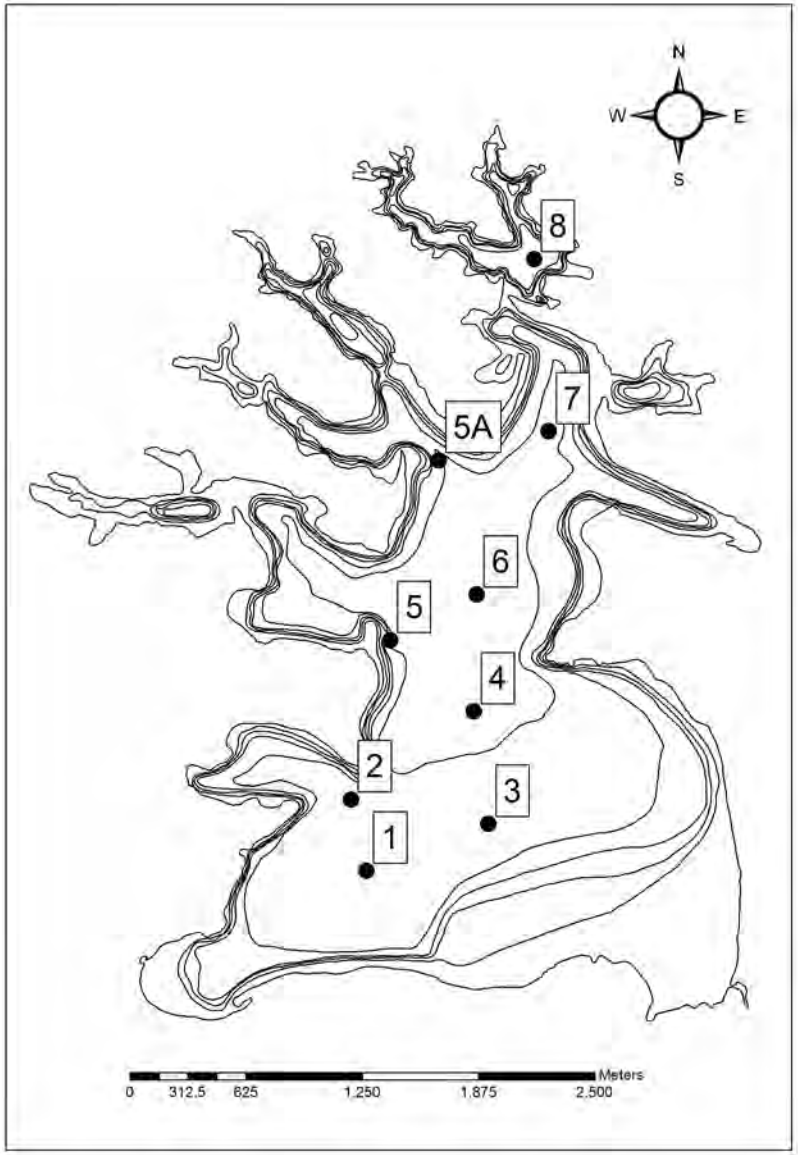
Schmidt stability.. High = water column more stable, Low = less stable



Dissolved oxygen



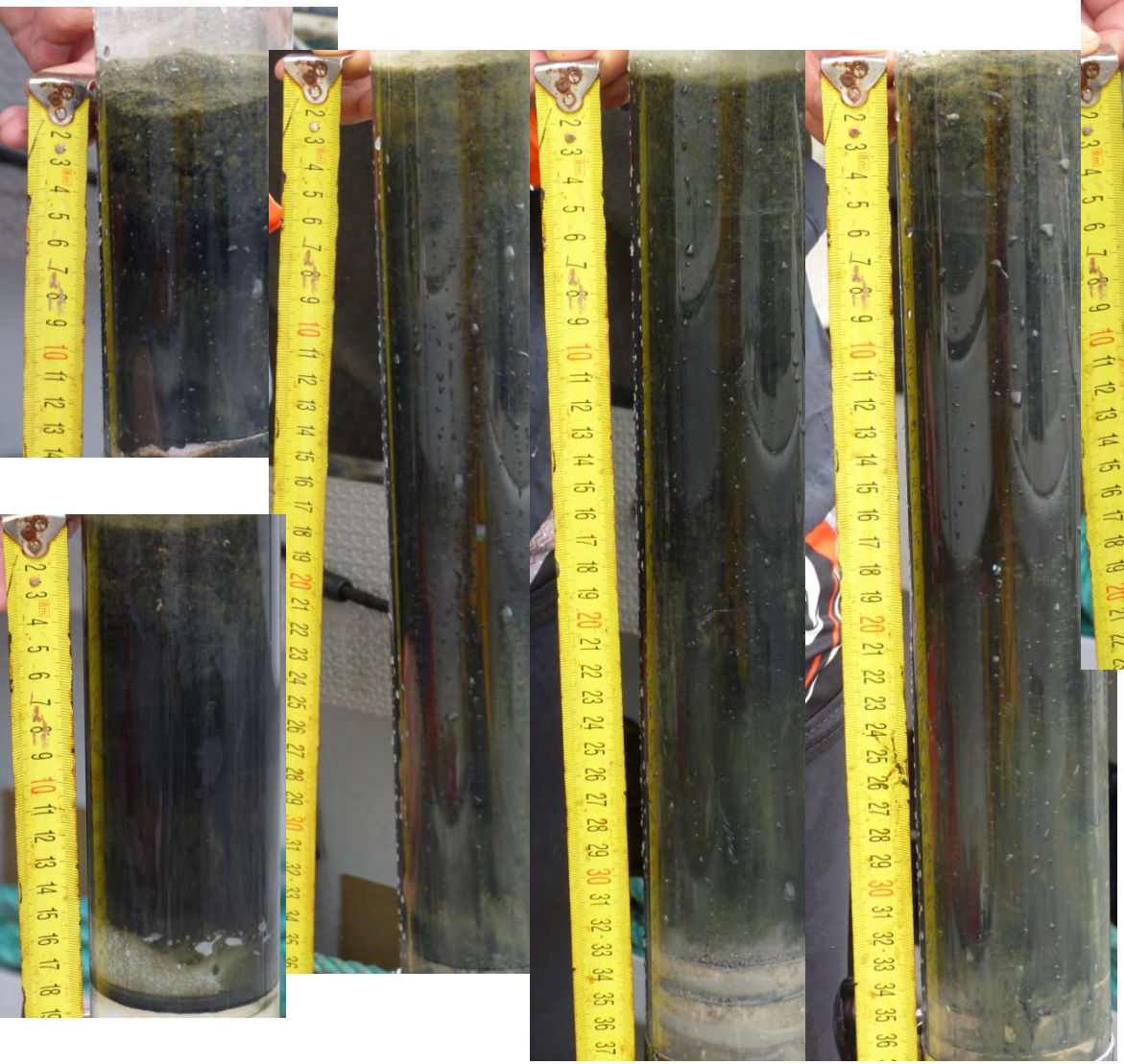
Sediment core – Chris Hendy

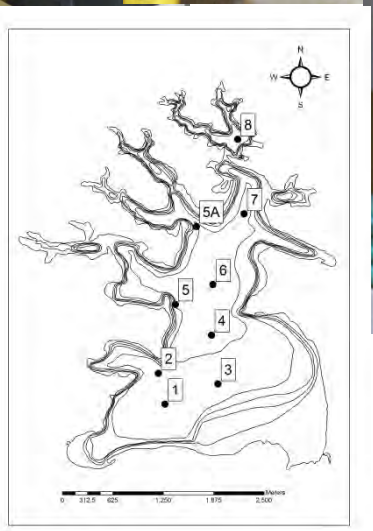


- Initial observations

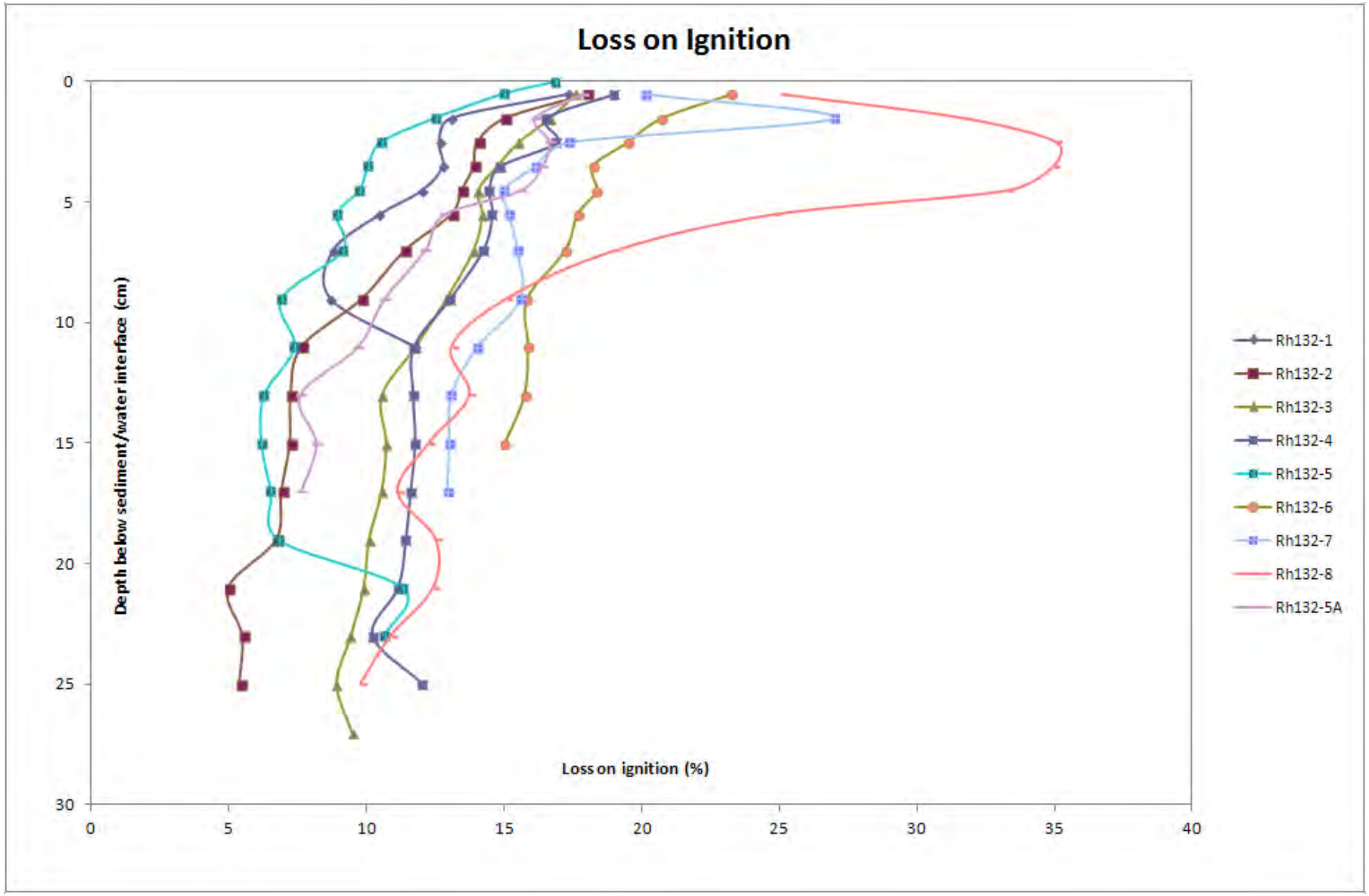
Sediments at site 8 were radically different to those from all other sites in the lake. All appeared to be diatomaceous ooze, but Site 8 were very much paler in colour with no darkening at depth.

Lake Rotoehu sediments – Progress Report



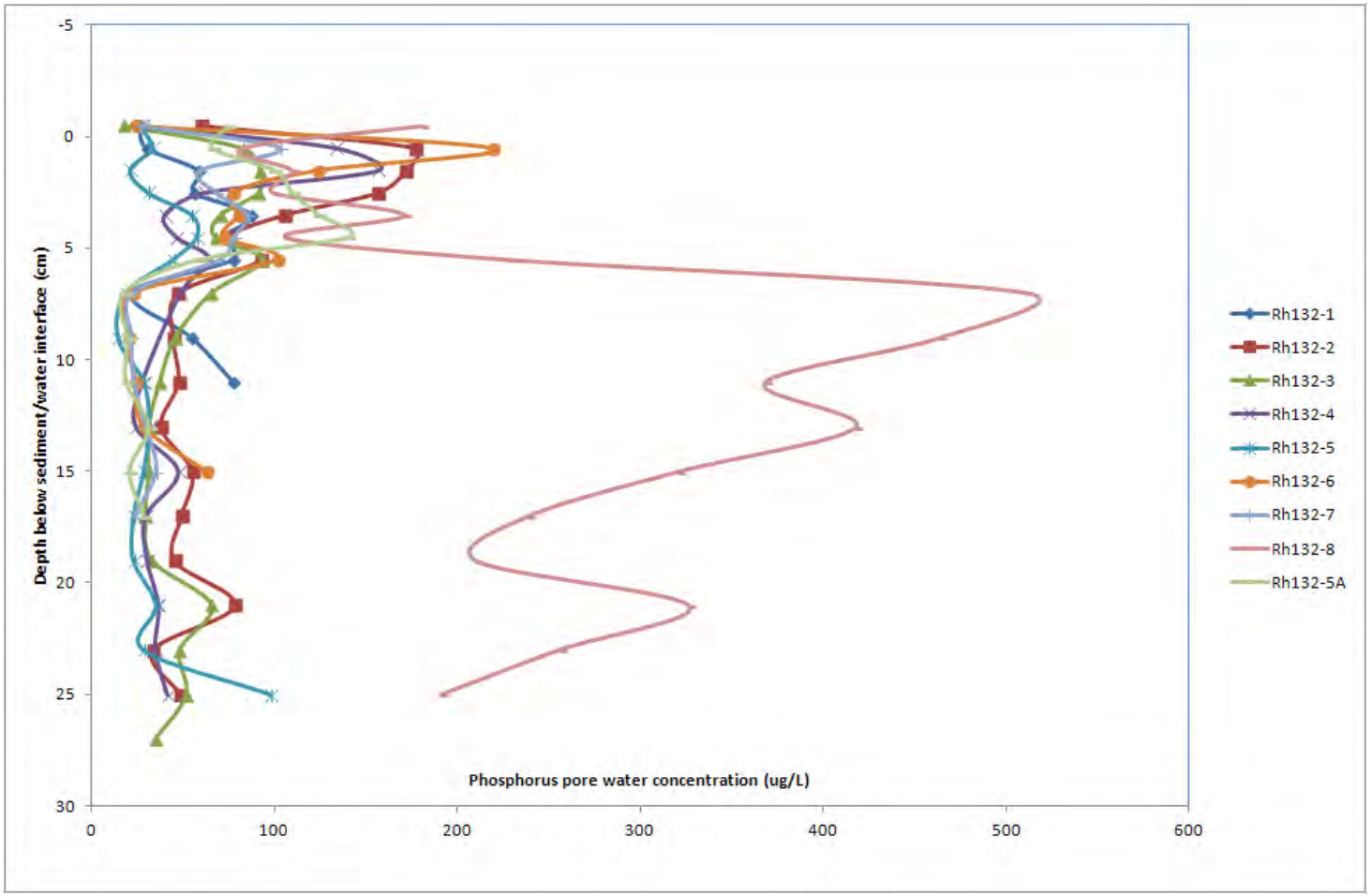


Lake Rotoehu sediments – Progress Report



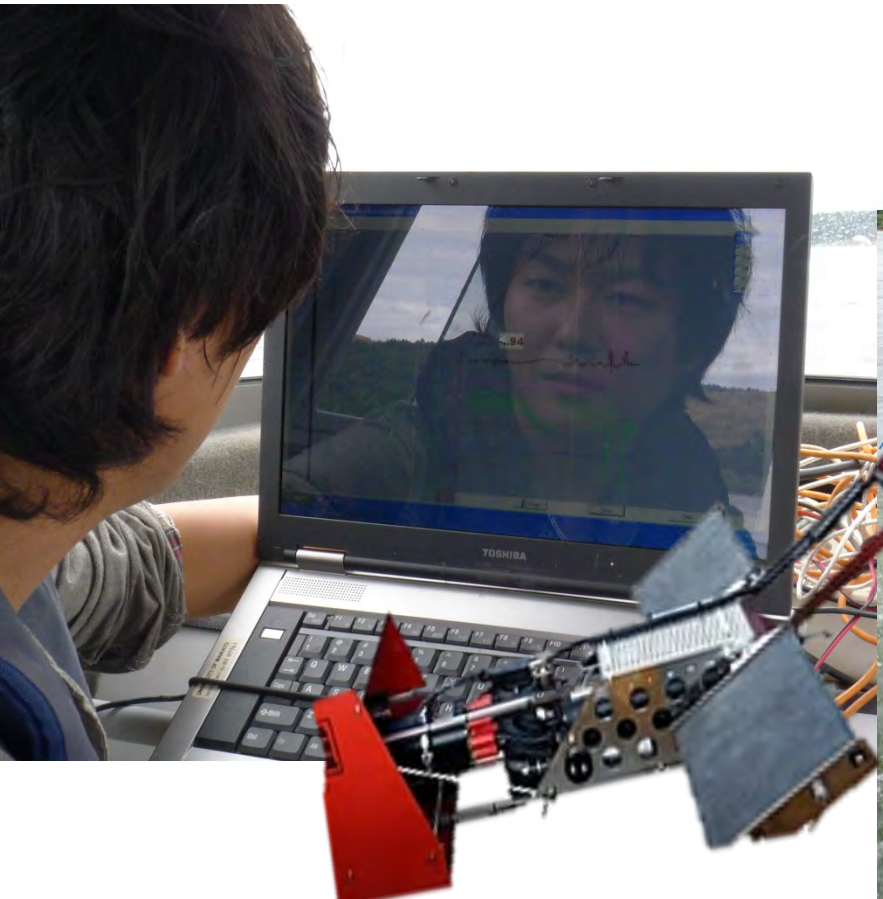
Lake Rotoehu sediments – Progress Report

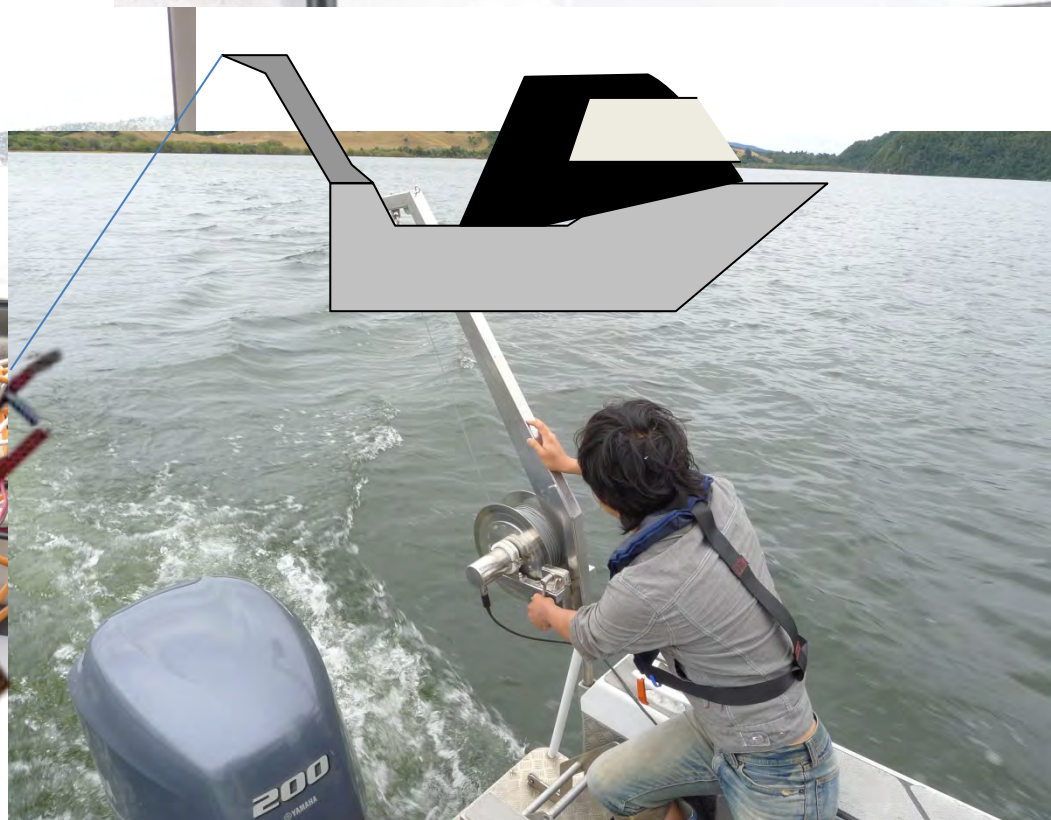
Phosphorus is being recycled from all sites except 8. Here it appears to be being swept down



Biofish

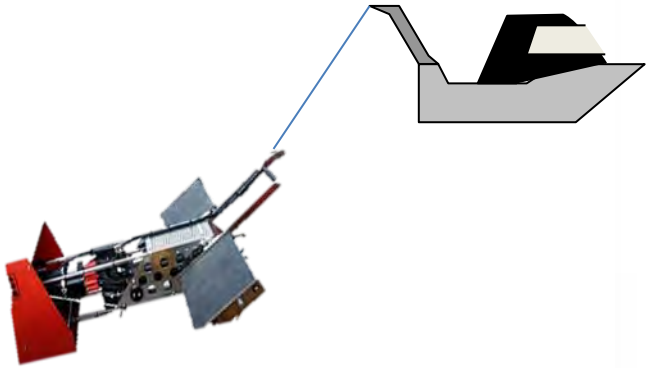
A device to acquire 2D sensor readings

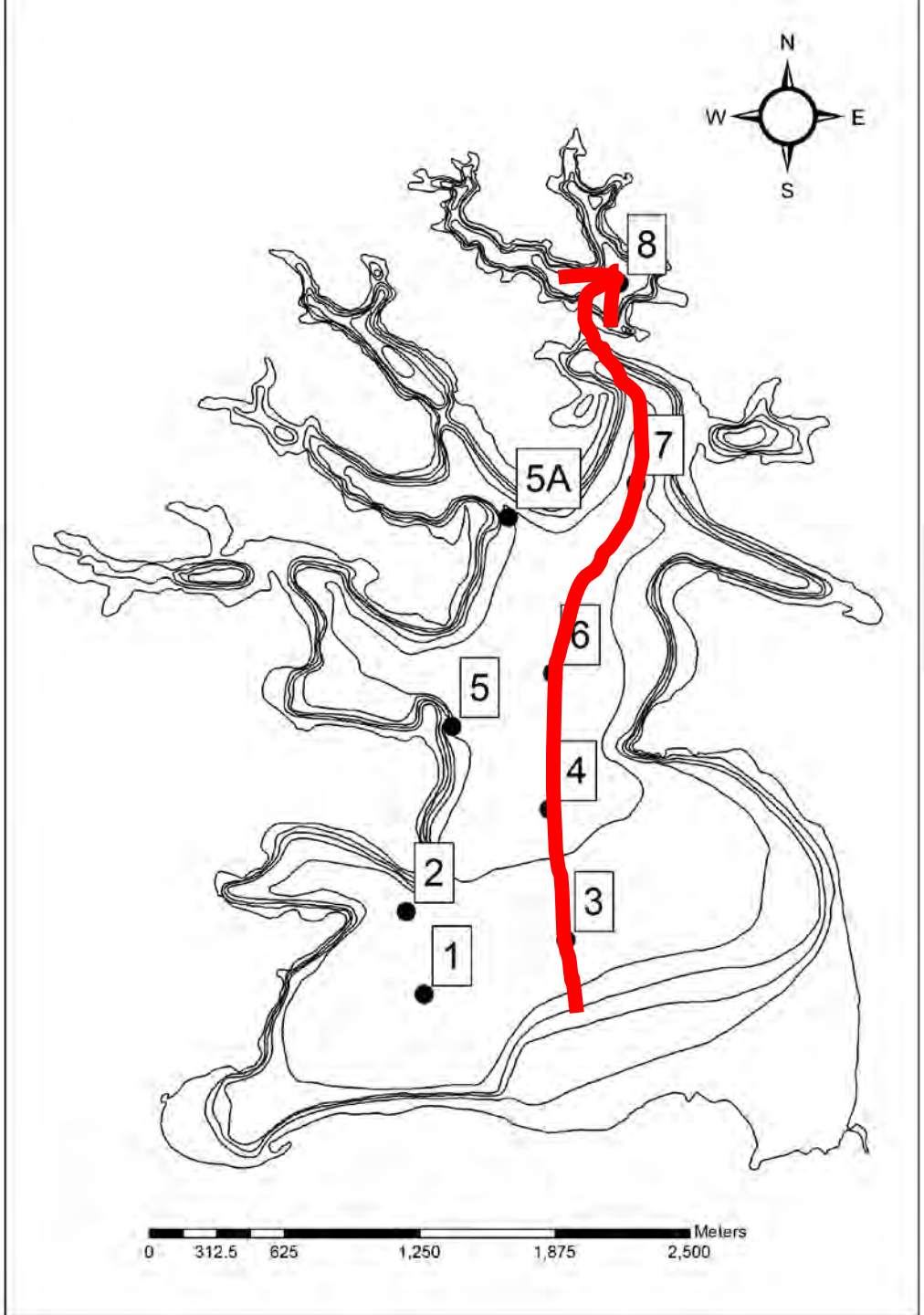


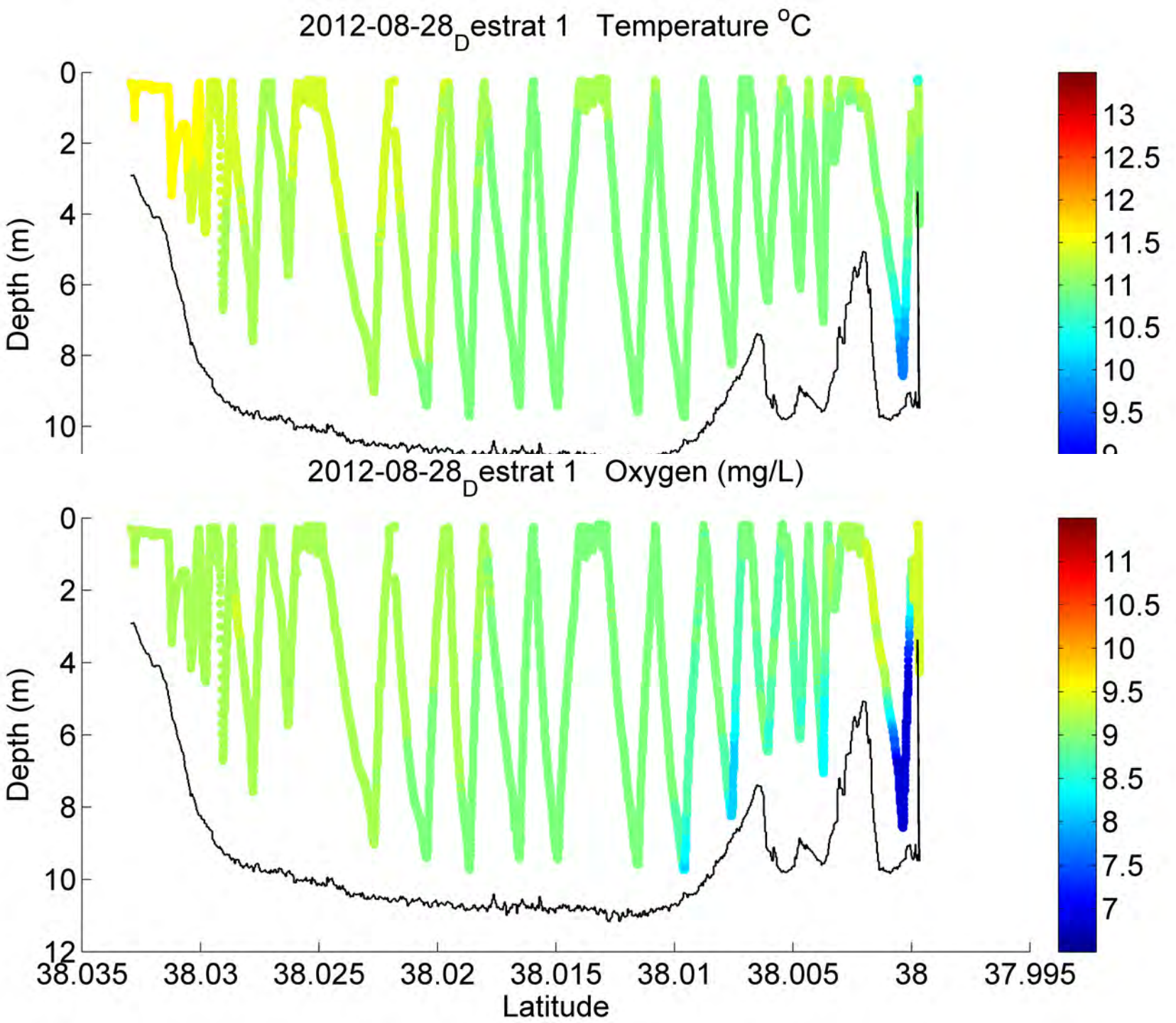


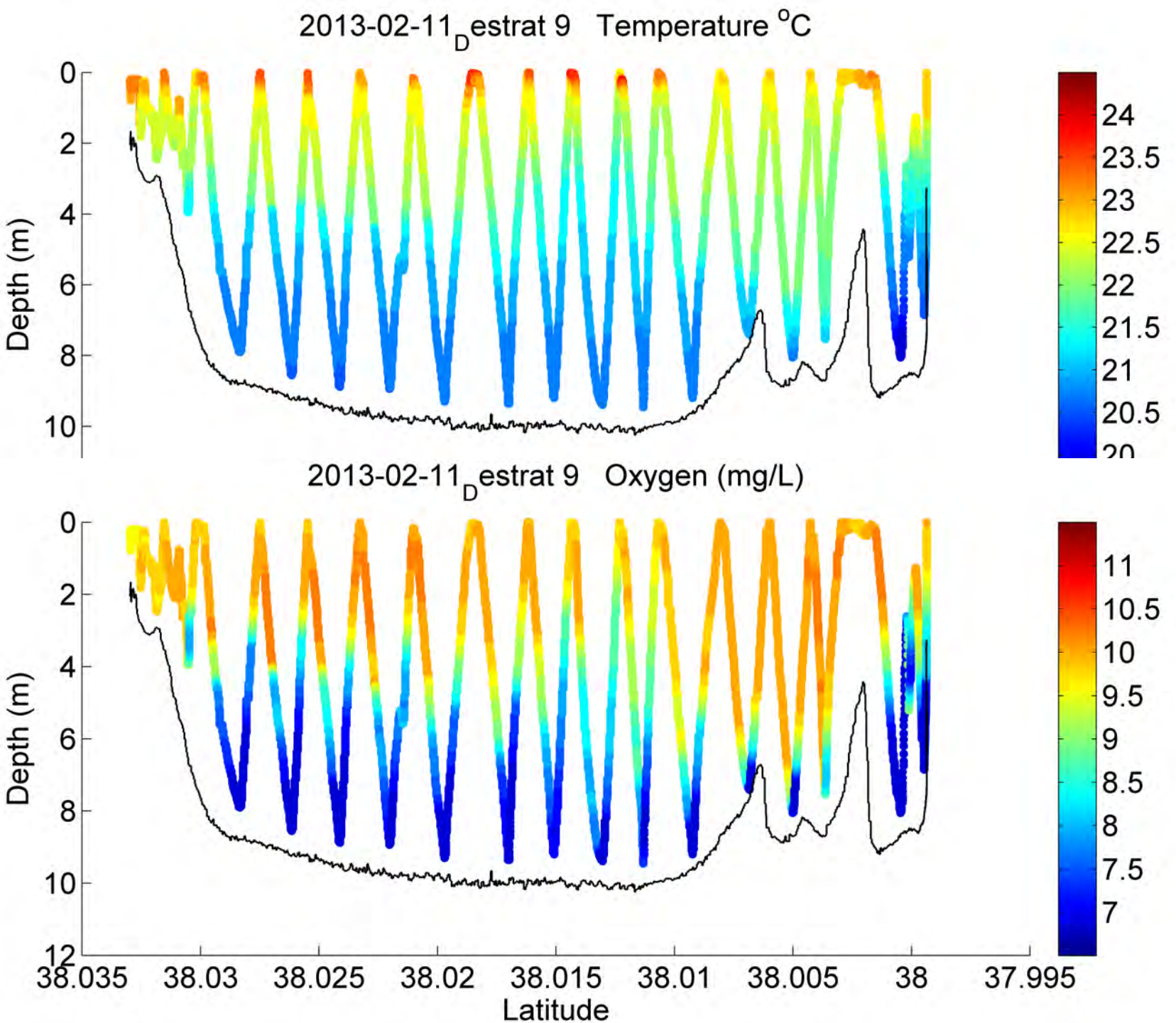
Biofish

2011-11-18	2013-01-31
2012-02-15	2013-02-08
2012-08-28	2013-02-11
2012-10-09	2013-02-22
2012-11-09	2013-02-26
2012-11-28	2013-02-27
2012-12-04	2013-02-28
2012-12-14	2013-03-01
2013-01-17	2013-03-21






2012-08-28_Destrat 1 Temperature °C
Depth (m)
0
2
4
6
8
10
13
12.5
12
11.5
11
10.5
10
9.5
2012-08-28_Destrat 1 Oxygen (mg/L)
Depth (m)
0
2
4
6
8
10
12
11
10.5
10
9.5
9
8.5
8
7.5
7
38.035
38.03
38.025
38.02
38.015
38.01
38.005
38
37.995
Latitude


2013-02-11_Destrat 9 Temperature °C
Depth (m)
0
2
4
6
8
10
24
23.5
23
22.5
22
21.5
21
20.5
2013-02-11_Destrat 9 Oxygen (mg/L)
Depth (m)
0
2
4
6
8
10
12
11
10.5
10
9.5
9
8.5
8
7.5
7
38.035
38.03
38.025
38.02
38.015
38.01
38.005
38
37.995
Latitude

Flow assessment

Dye release

- February 26th – 27th
- Rhodamine WT (pink dye)

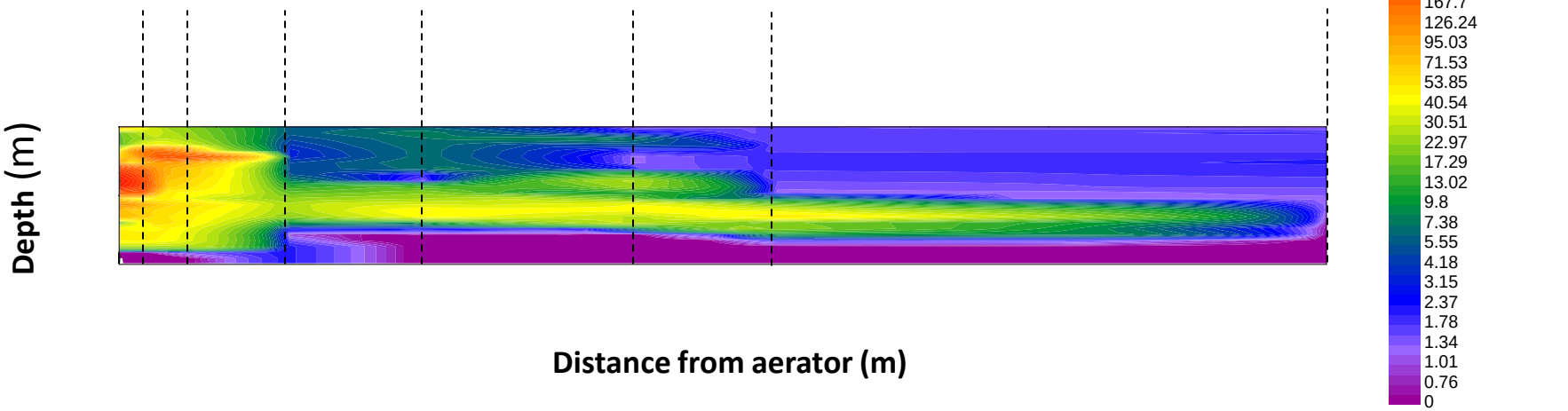
Dye trace

- Sensor detection
- Satellite images
  - **Formosat 2 (Taiwanese High-resolution satellite)**
  - Multispectral – 8m resolution
  - Panchromatic – 2m resolution

Sensor reading - Max

Manual dye profiles along the N-W (A) plume
From the Aerator 27/02/2013

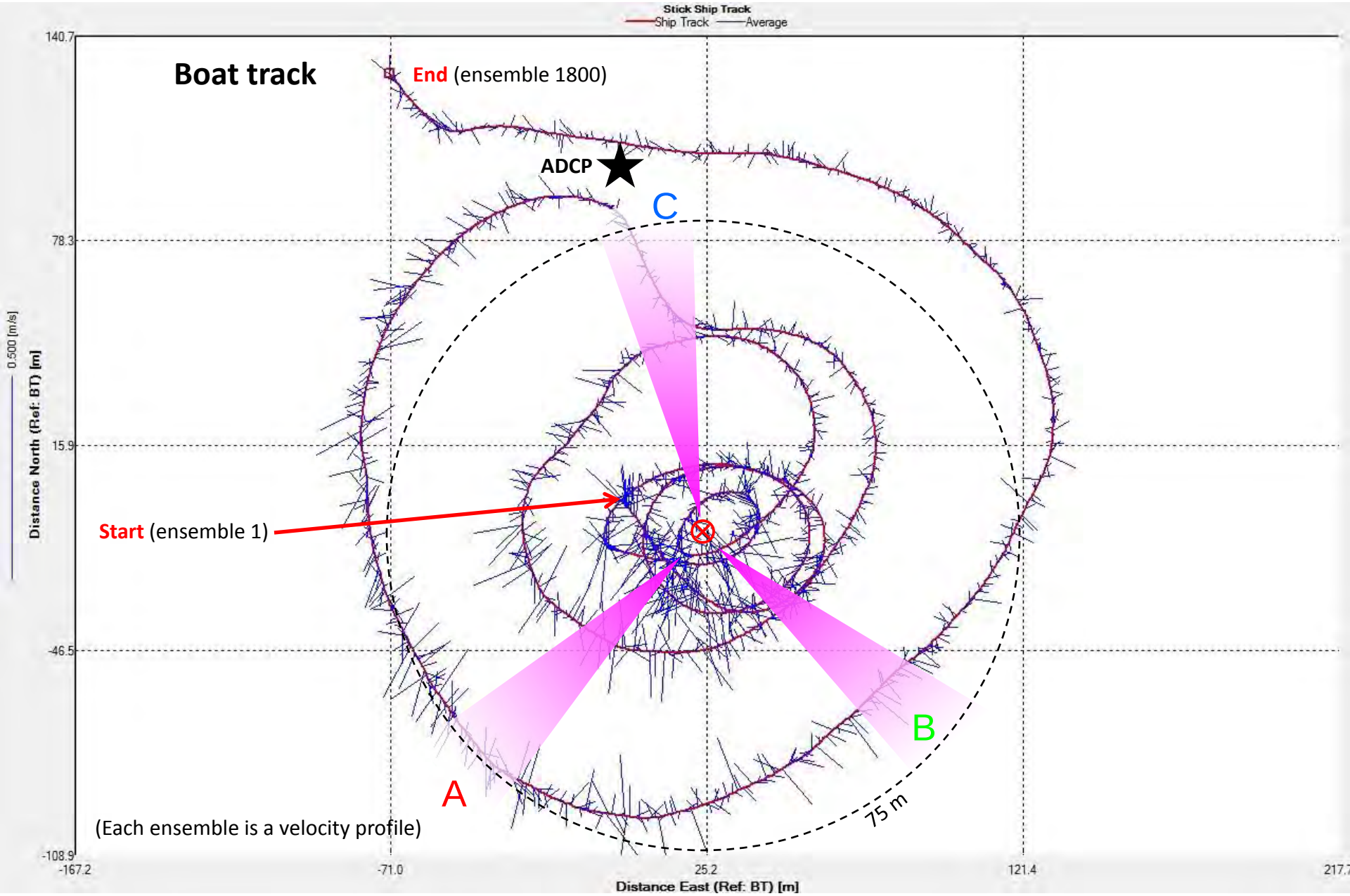
(There was no dye below the thermocline)

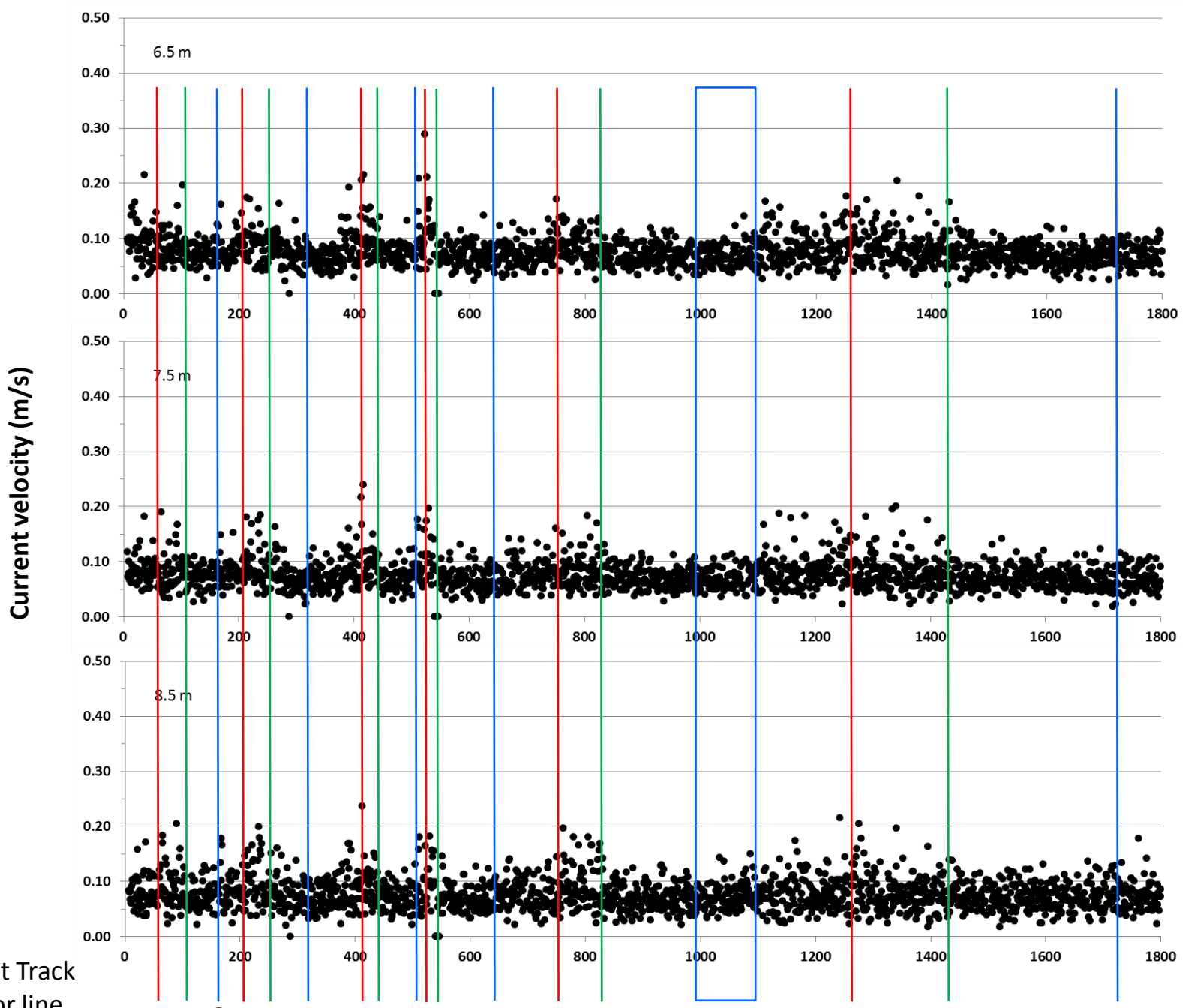


(Vertical lines are profiling points; Graphed using triangulation with a ratio of 12:1)

Flow assessment

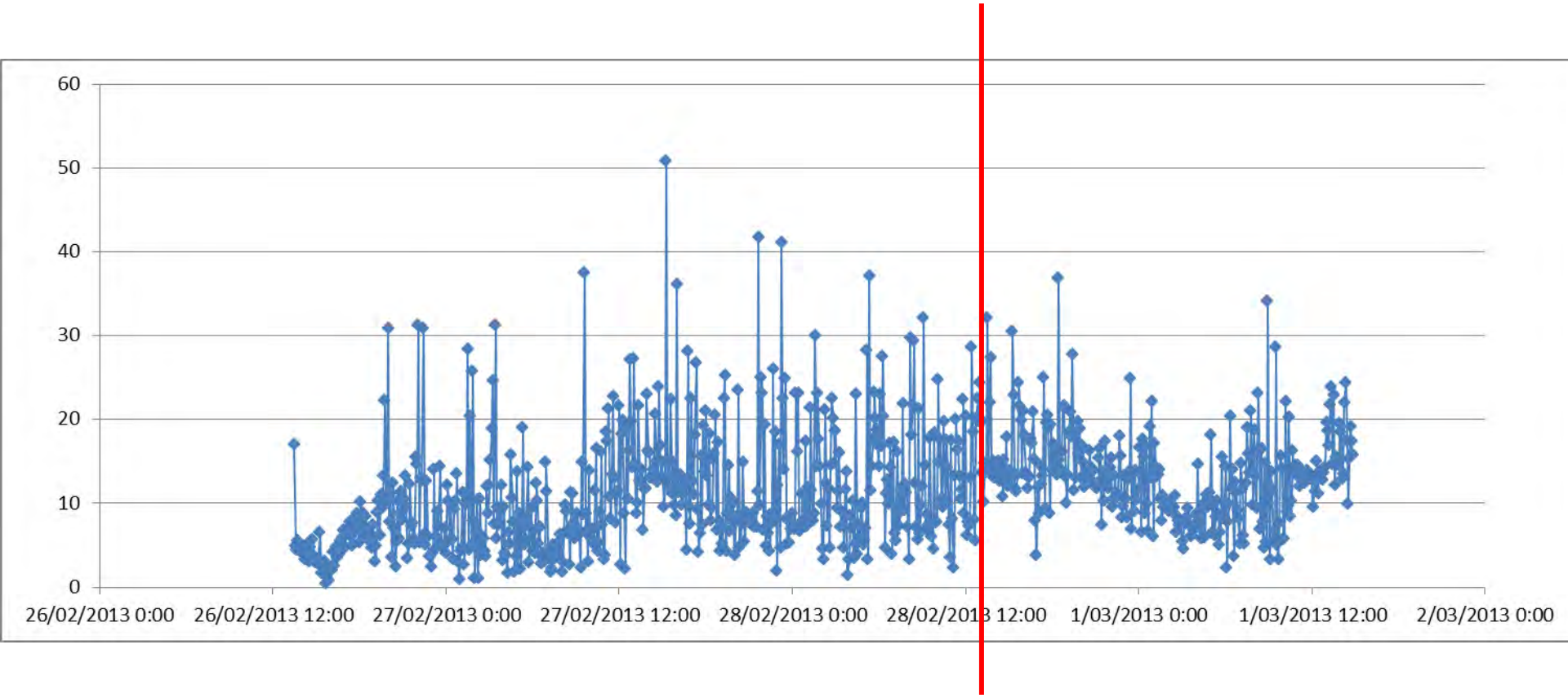
- NIWA ADCP boat to cover entire lake surface
- NIWA ADCP measurements
- Two flow meter readings


Stick Ship Track
Ship Track
Average
Boat track
End (ensemble 1800)
ADCP
C
Start (ensemble 1)
A
B
75 m
(Each ensemble is a velocity profile)
140.7
78.3
15.9
-46.5
-108.9
-167.2
-71.0
25.2
121.4
217.7
Distance North (Ref: BT) [m]
Distance East (Ref: BT) [m]
0.500 [m/s]


6.5 m
7.5 m
8.5 m
Current velocity (m/s)
0.50
0.40
0.30
0.20
0.10
0.00
0
200
400
600
800
1000
1200
1400
1600
1800
See Boat Track figure for line direction
A B C
ADCP ensemble Number

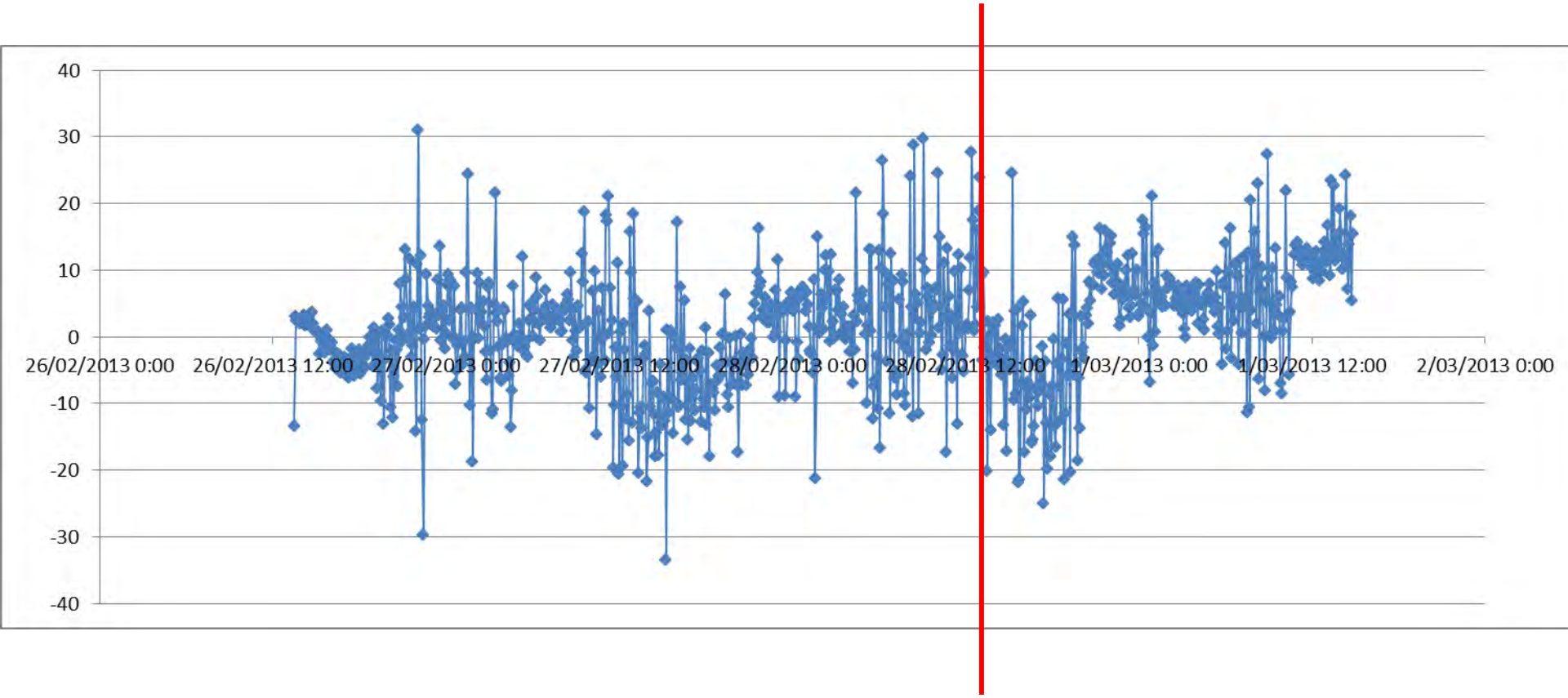
Flow meter

Flow speed



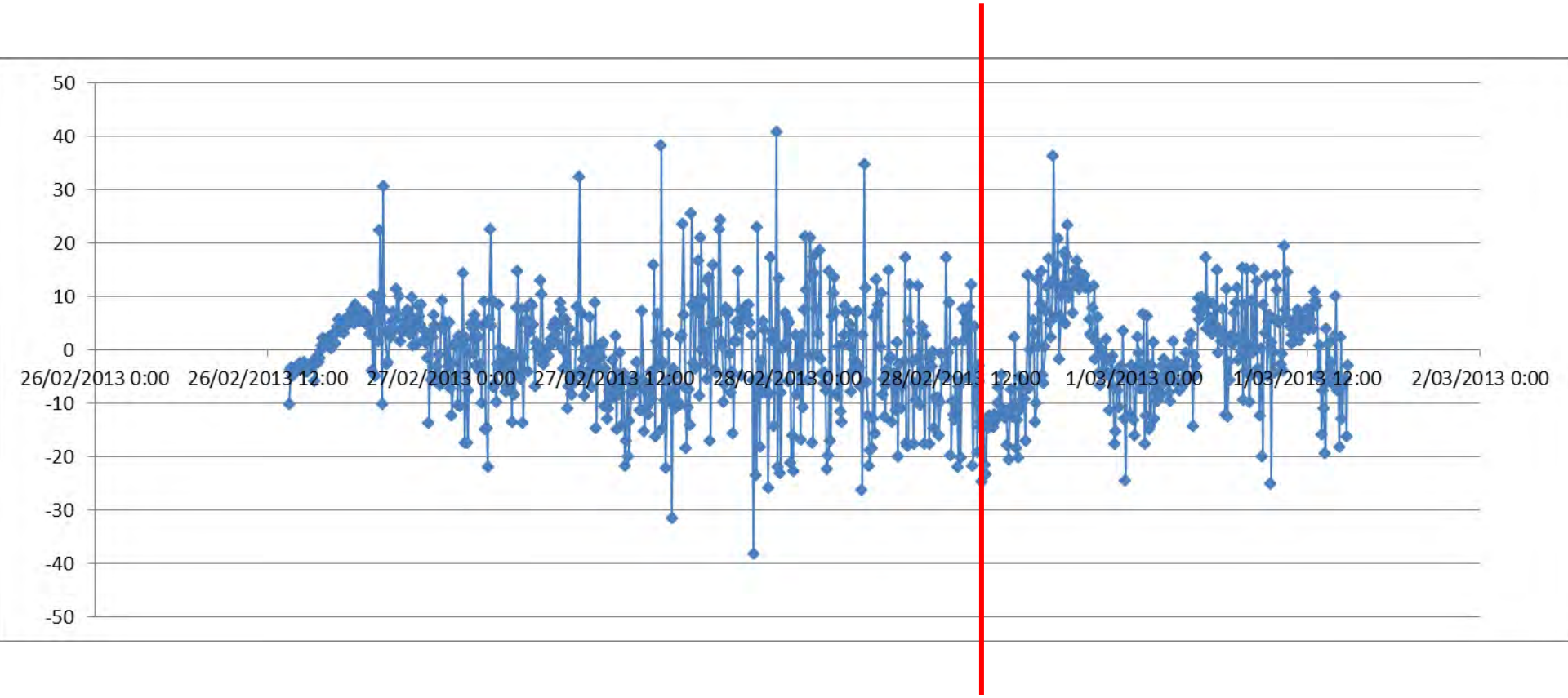
Flow meter

- N-S flow

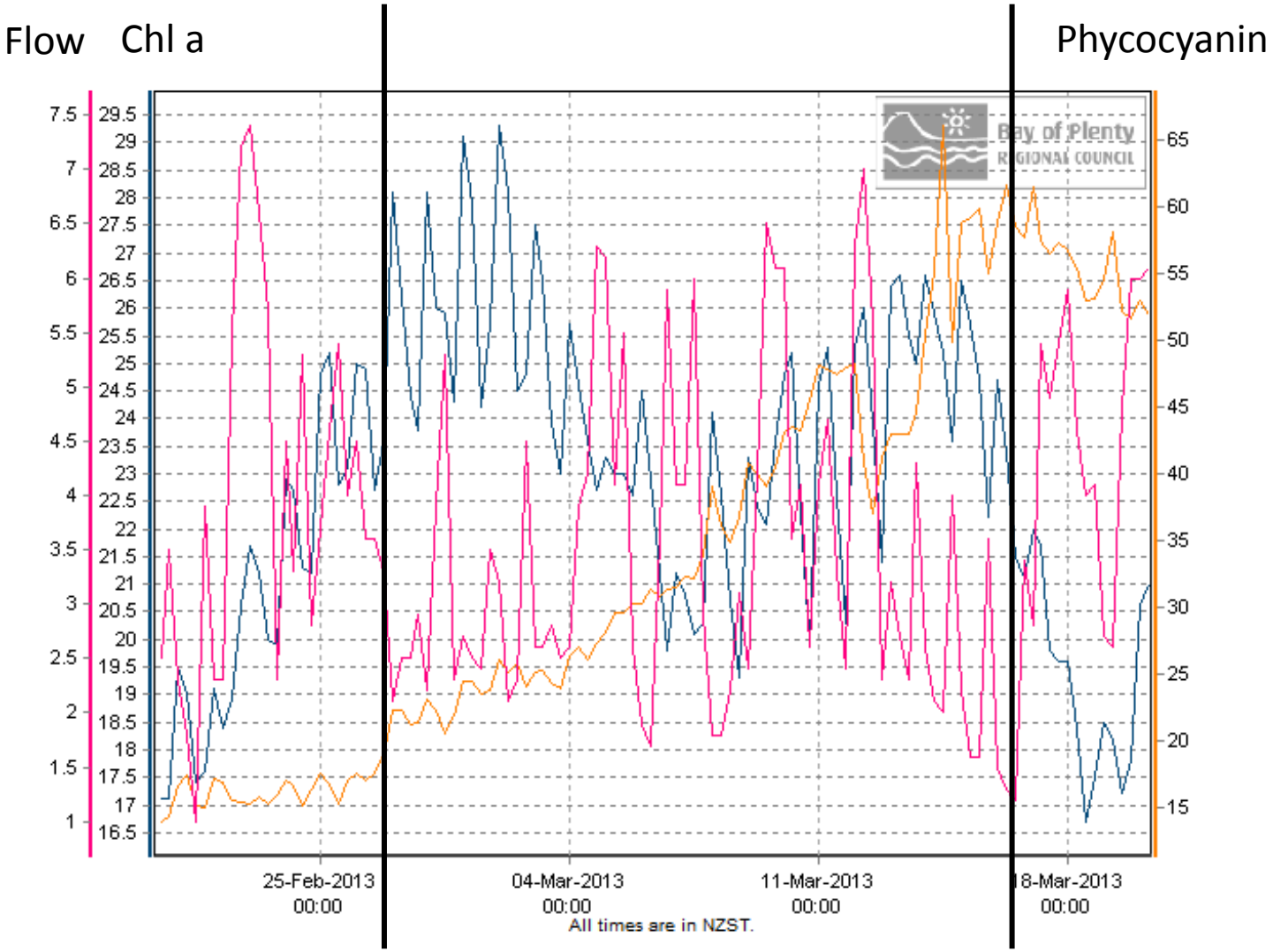


Flow meter

- N-S flow

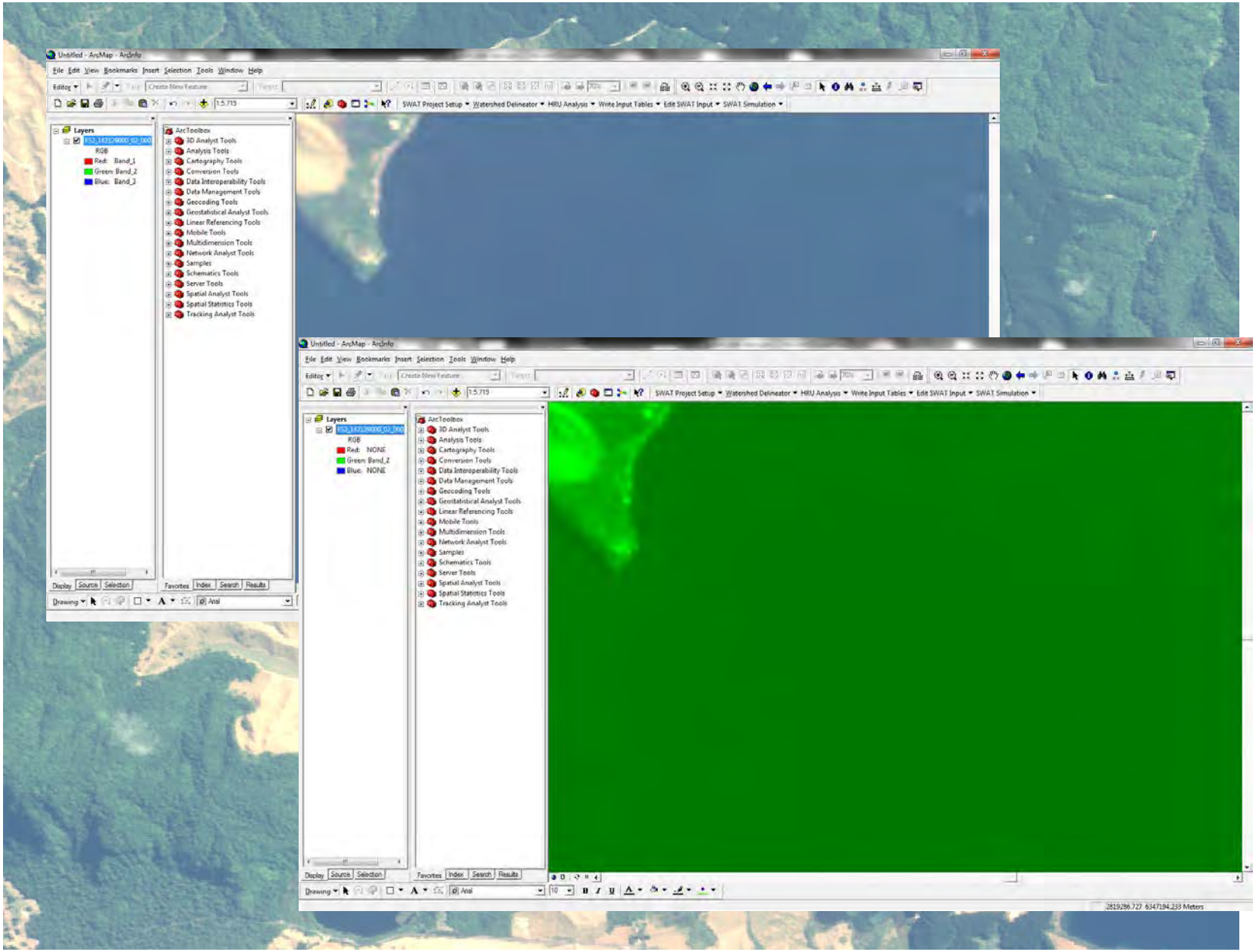


Lake Buoy readings

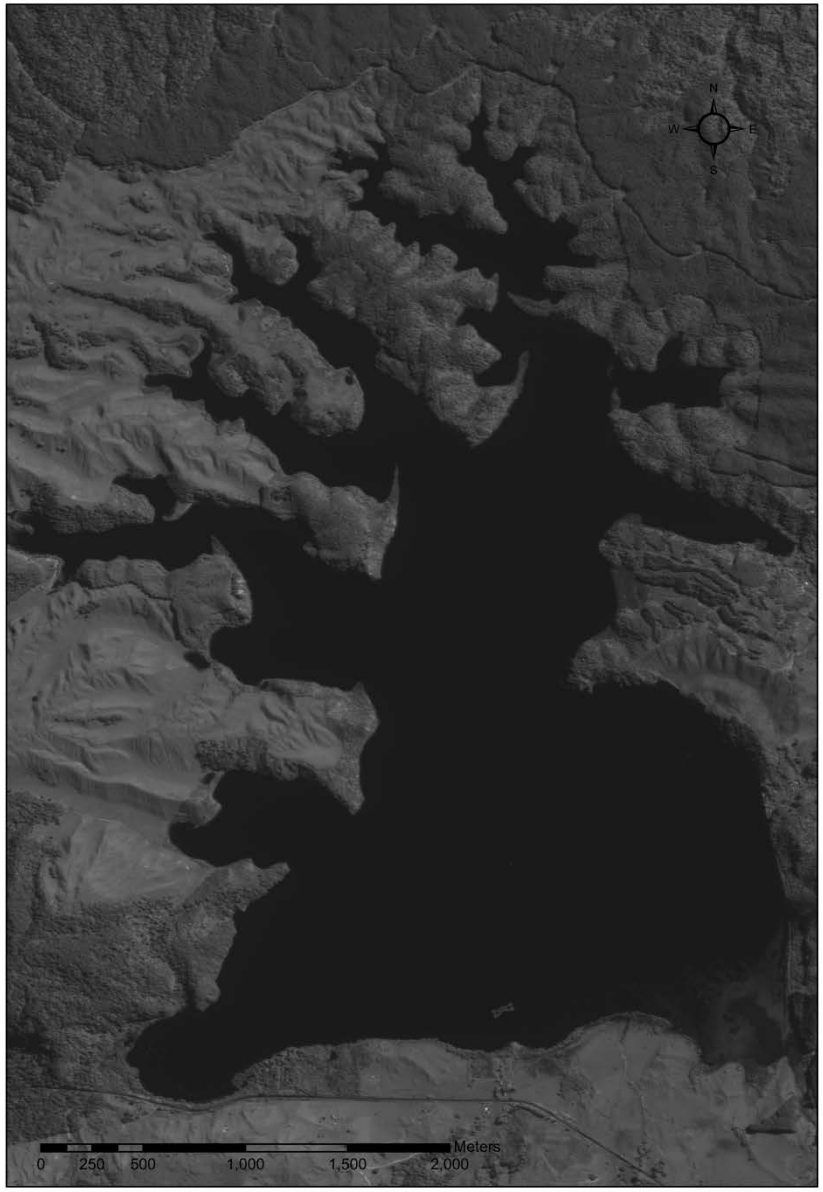


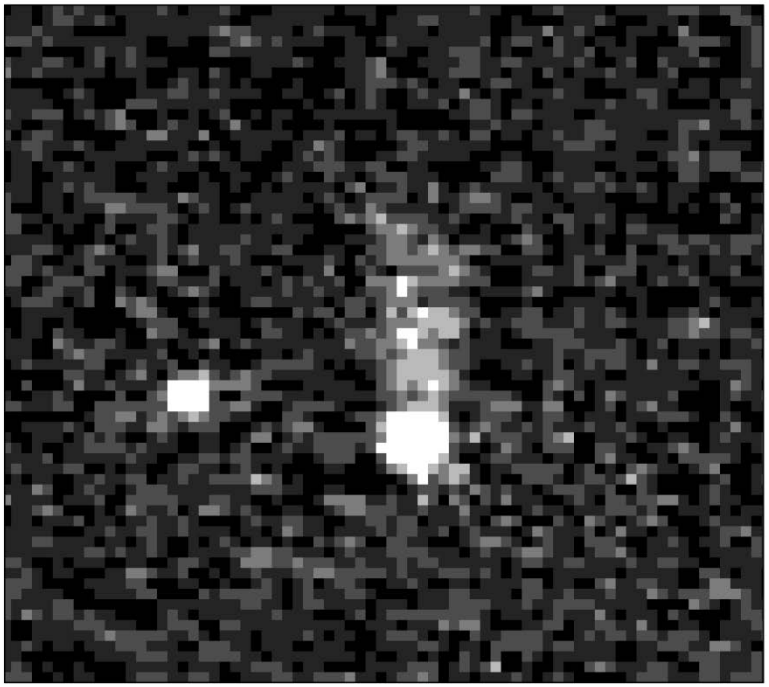
FORMOSAT 2
26th March 2013

26th Multispectral (8m grid)



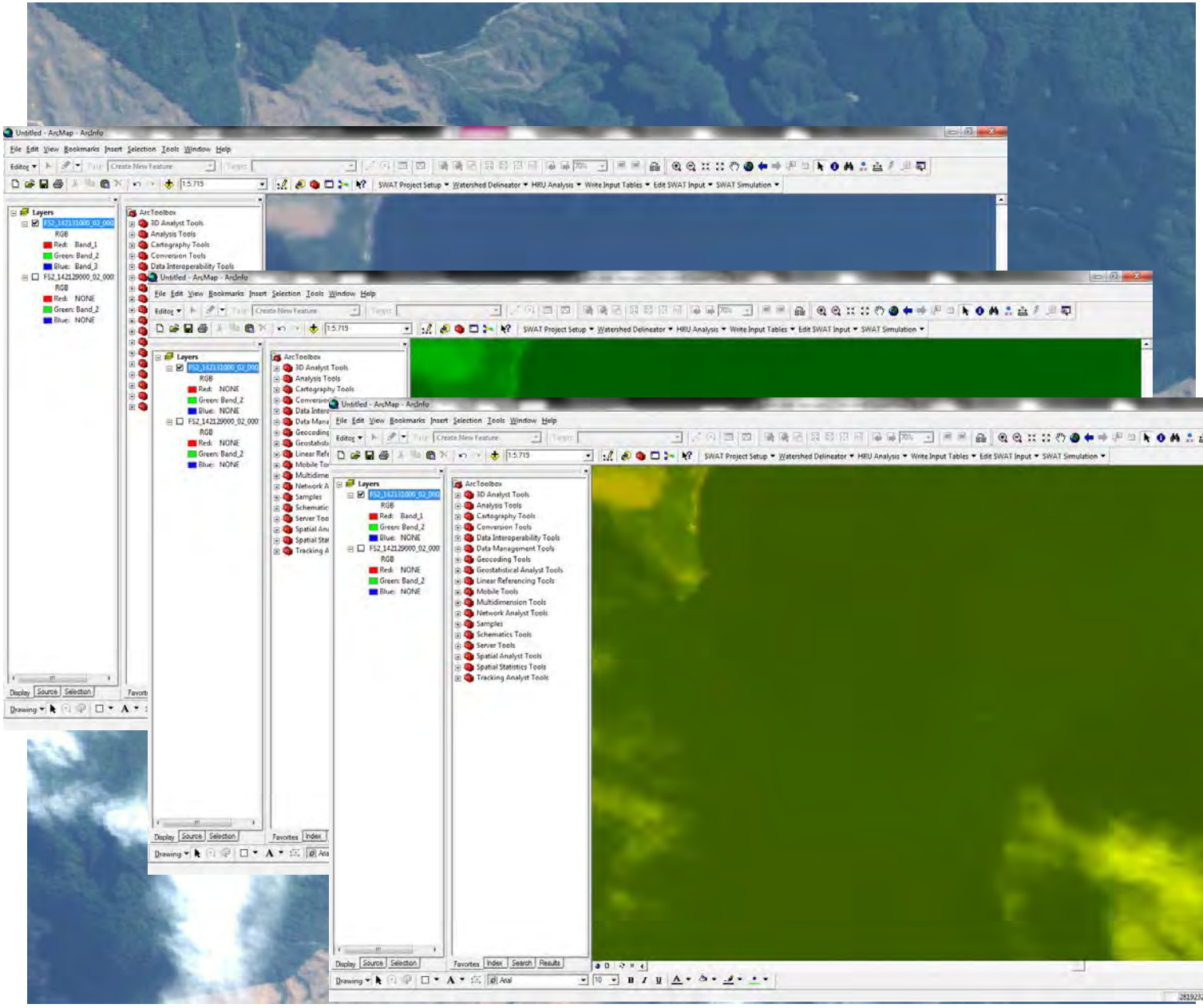
26th Panchromatic (8m grid)





FORMOSAT 2
26th March 2013

26th Multispectral (8m grid)



27th Panchromatic (8m grid)