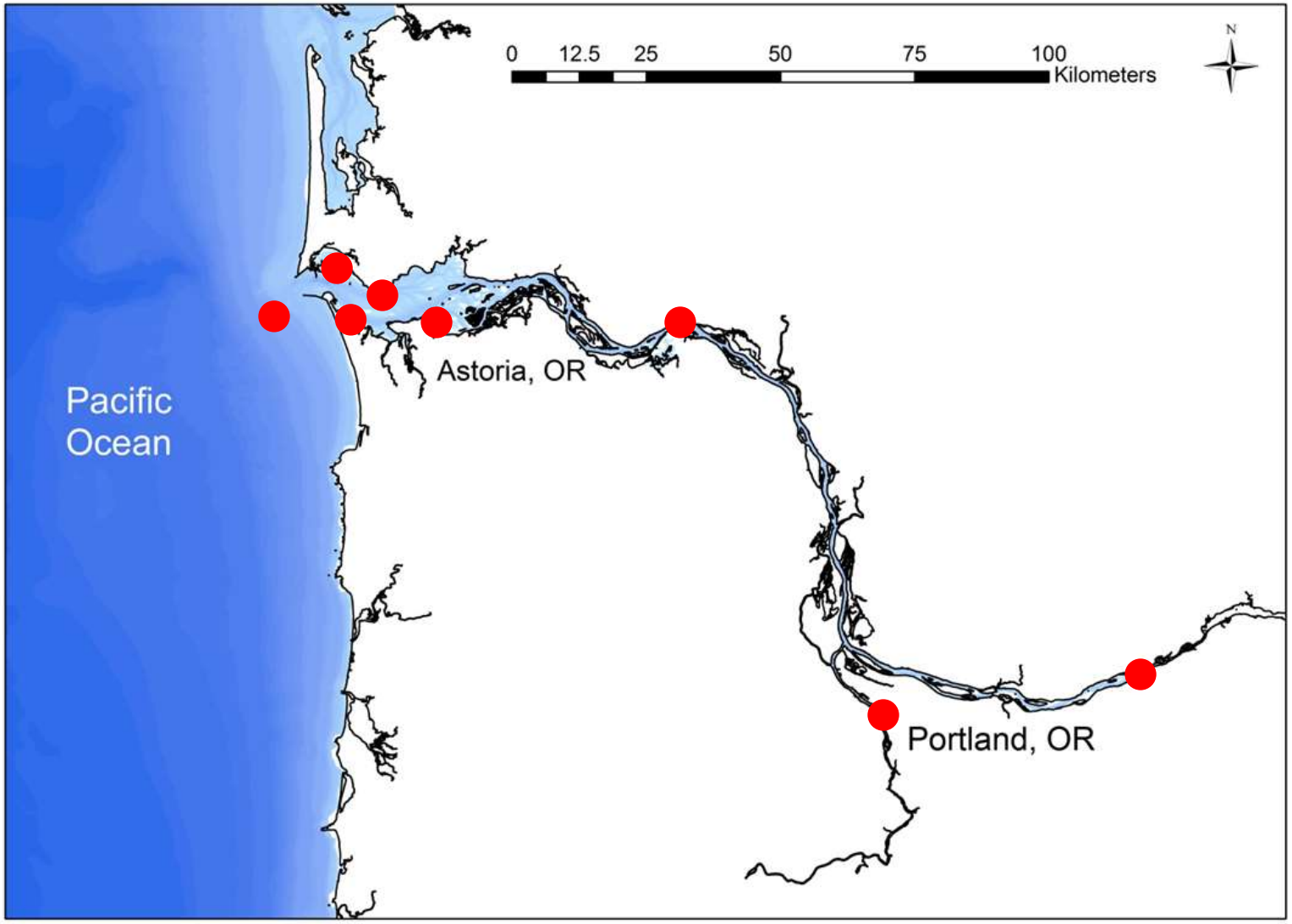
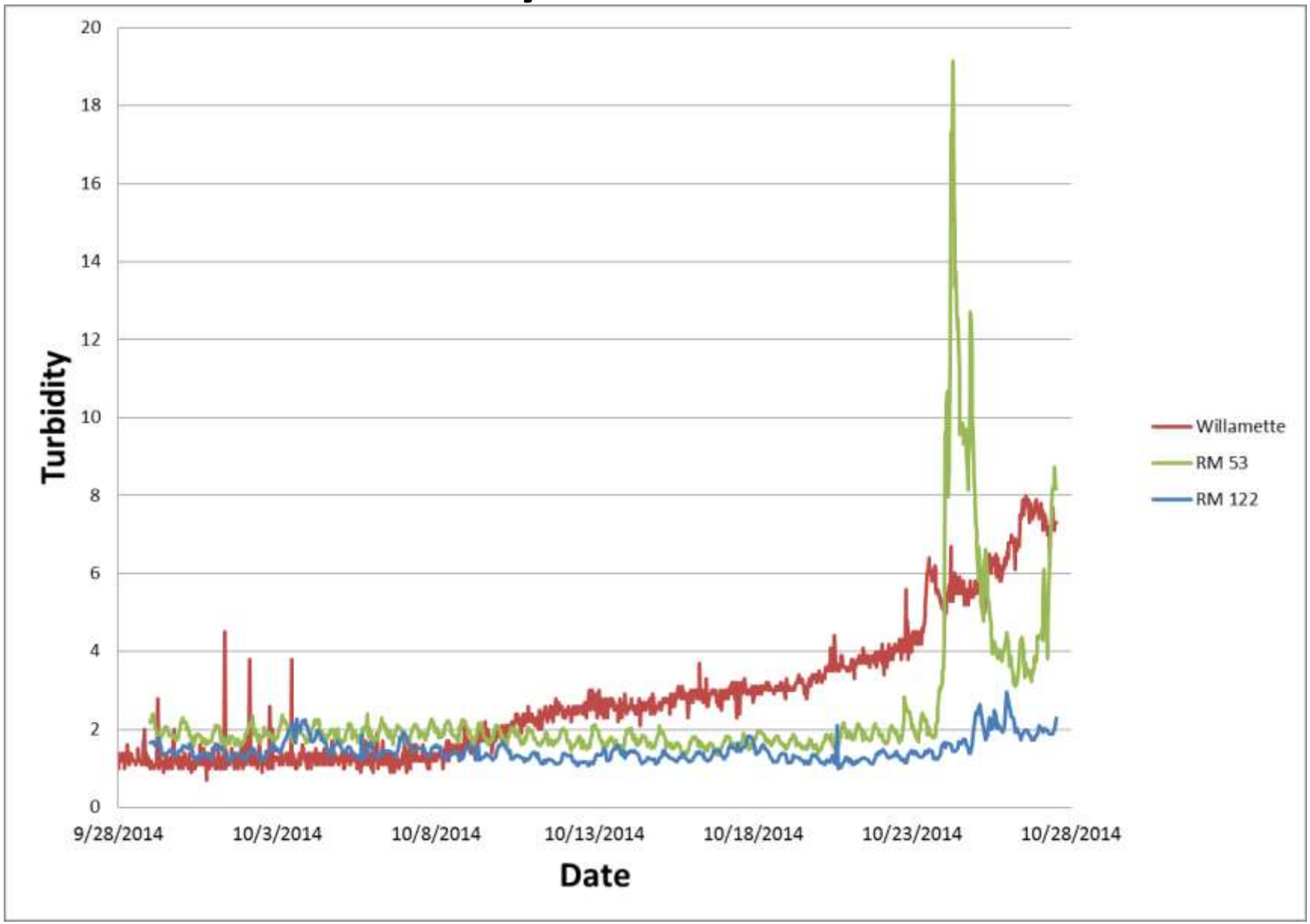
EMP mainstem conditions: in situ observations

Joseph Needoba

Biogeochemical Platforms



Turbidity at 3 locations



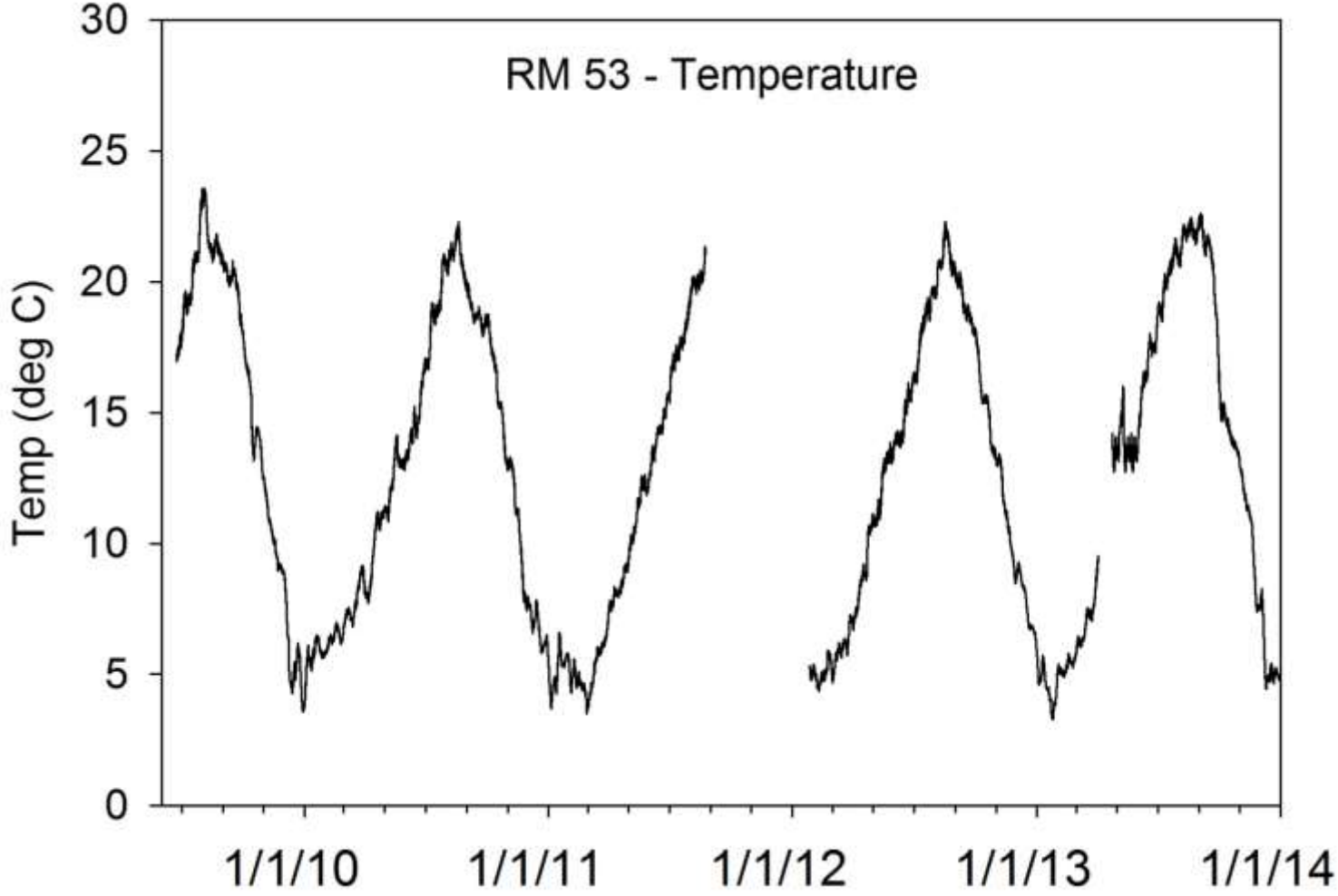
RM-53 Platform Design

Real time data

Latest

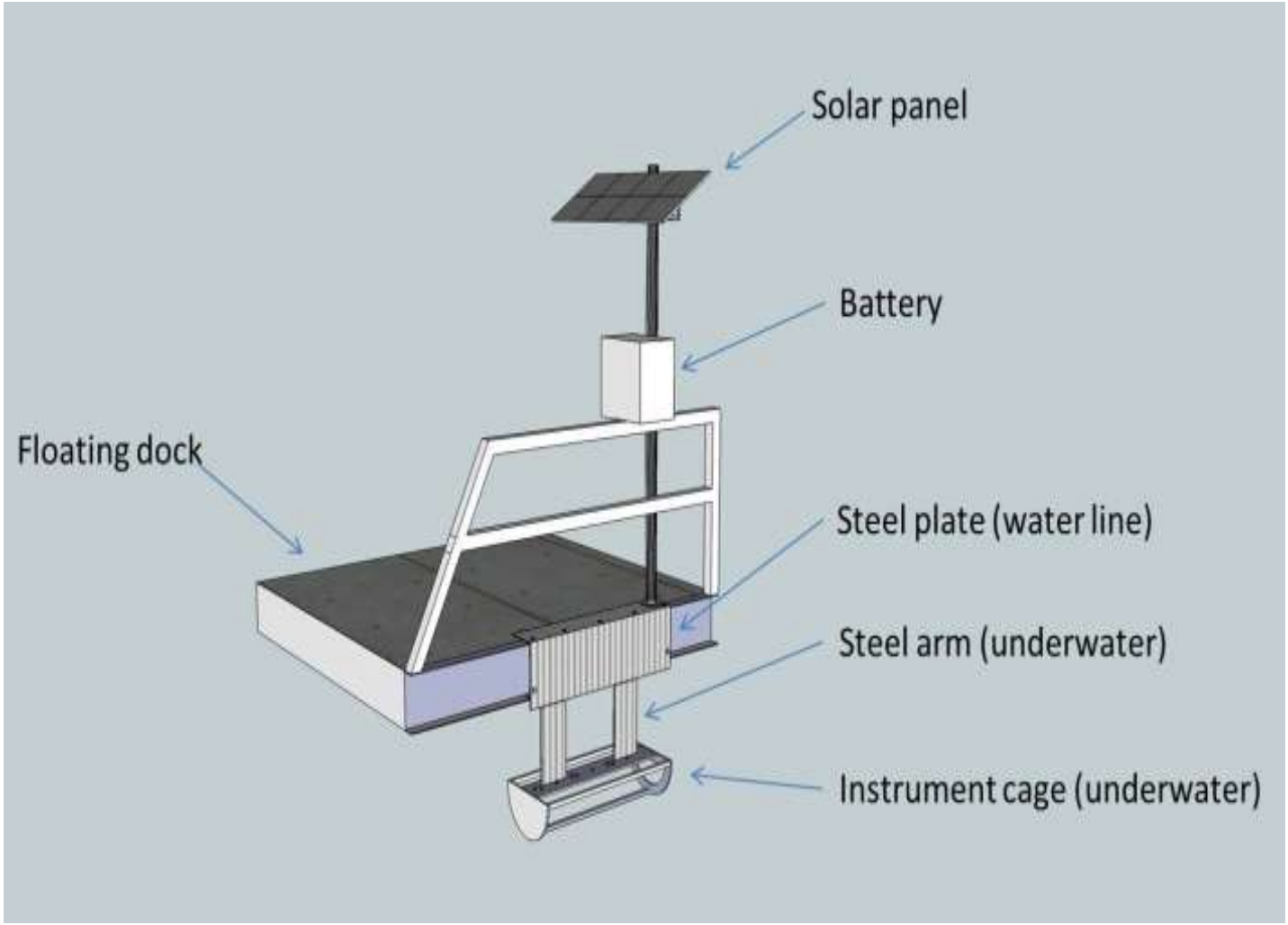
Lower Columbia River
2012-02-20 11:00:00 PST

CDOM	23.11	QSDE
Chlorophyll	6.68	µg/L
Conductivity	0.0090	S/m
Depth	3.822	m
Dissolved O_2	9.23	ml/l
Nitrate	29.7	µM
O_2 Saturation	8.90	ml/l
O_2 % Saturation	103.7	%
Salinity	0.07	PSU
Temperature	5.10	°C
Turbidity	4.90	NTU
Battery Voltage	12.8	V

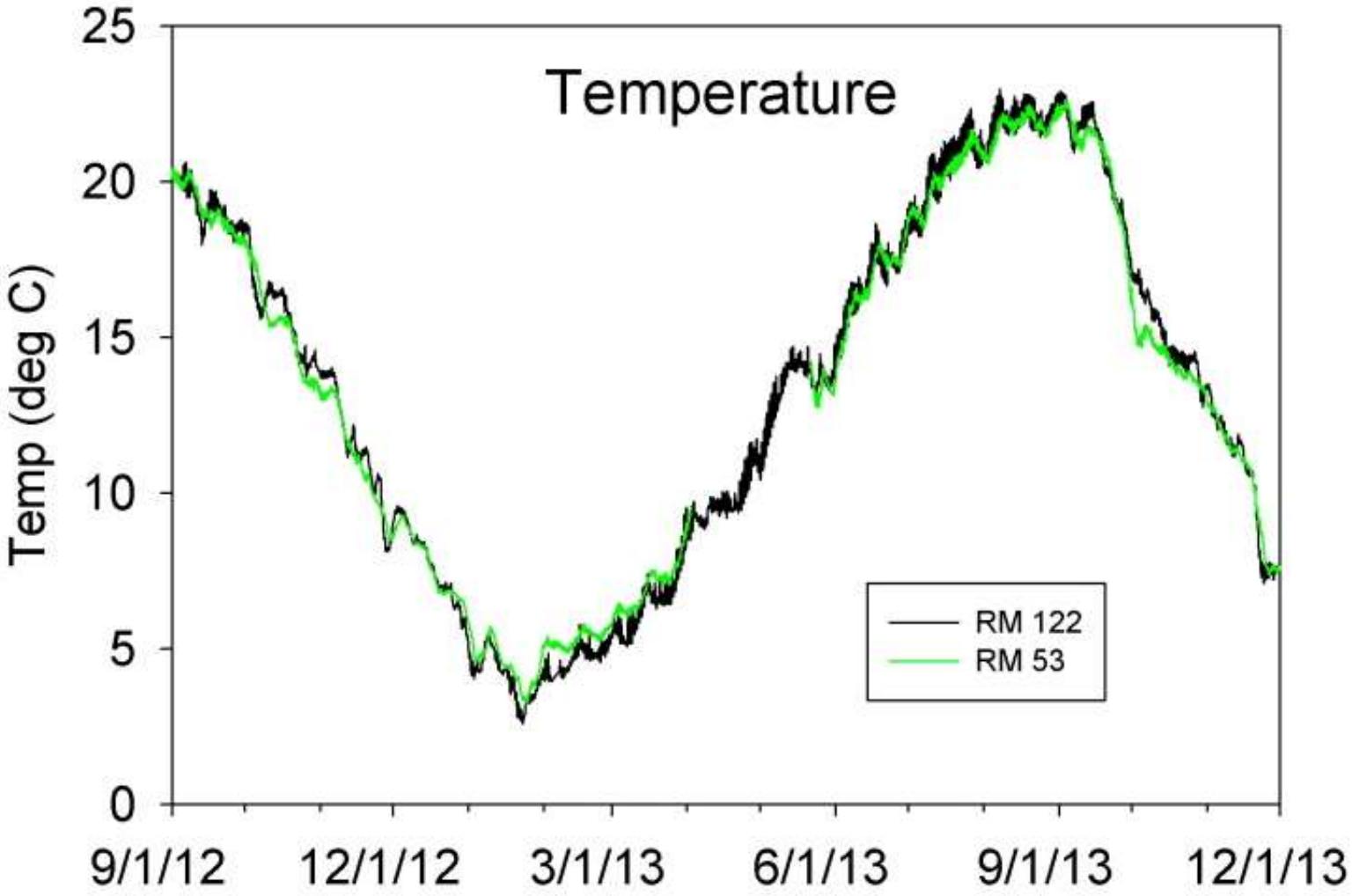


	2009	2010	2012	2013	2014
Total > 19°C	82	51	55	81	84

RM-122 Platform Design



Comparison between stations

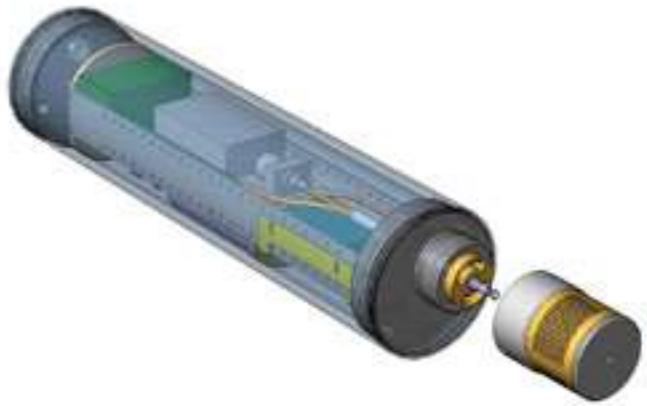


Instruments and Measurements

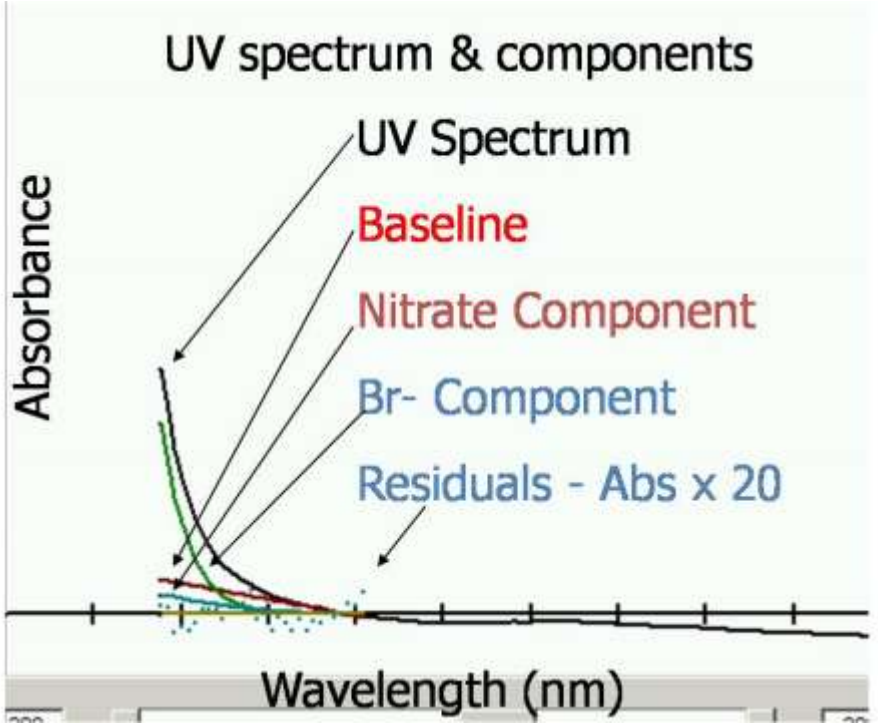
Company	Sensor	Parameters
Satlantic	LOBO	Power distribution Sensor control Wireless communication Data management
Satlantic	SUNA Nitrate	Nitrate Concentration
WET Labs	ECO-CDS	Colored Dissolved Organic Matter (CDOM)
WET Labs	WQM Water Quality Monitor	Conductivity, Temperature, Dissolved Oxygen, Turbidity, Chlorophyll Concentration
WET Labs	Cycle PO4	Ortho-Phosphate

Nitrate Measurements

- ISUS (In Situ Ultraviolet Spectrophotometer)
- Optical sensor for NO_3^-



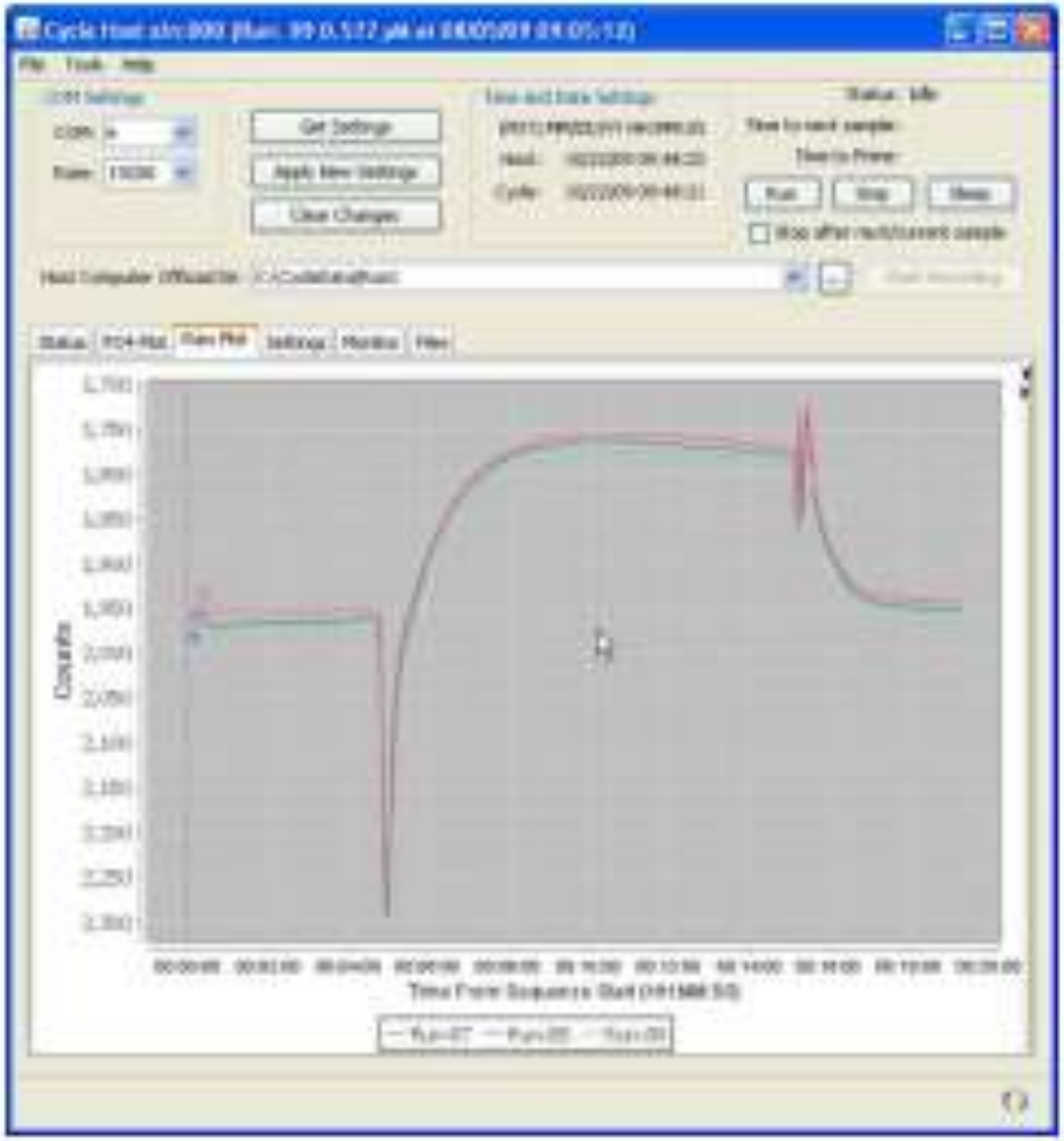
ISUS sensor with anti-fouling filter



Significant improvements to the nitrate calculation:

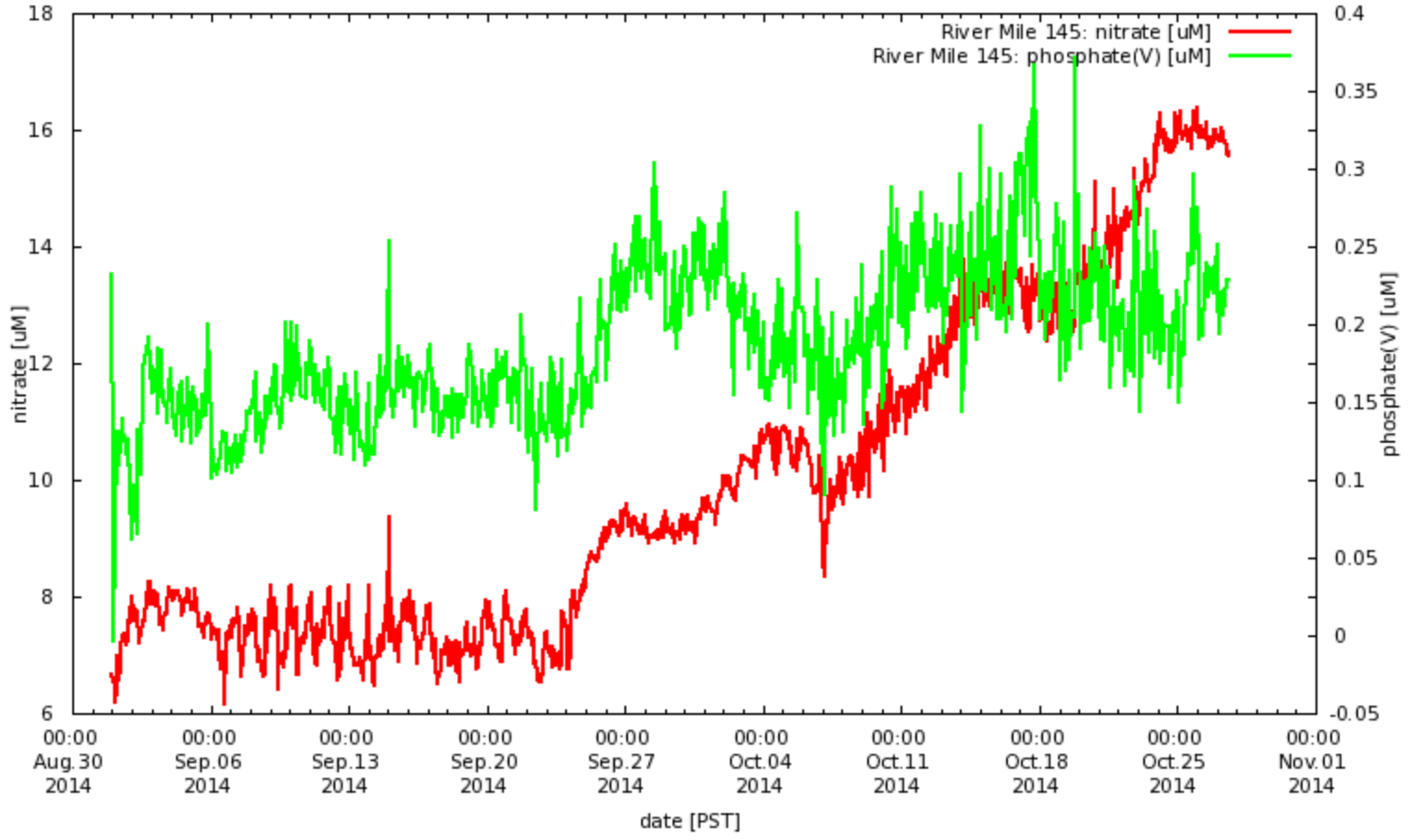
Carole M. Sakamoto, Kenneth S. Johnson, Luke J. Coletti
Limnol. Oceanogr.: Methods 7, 2009, 132–143

Phosphate Sensors

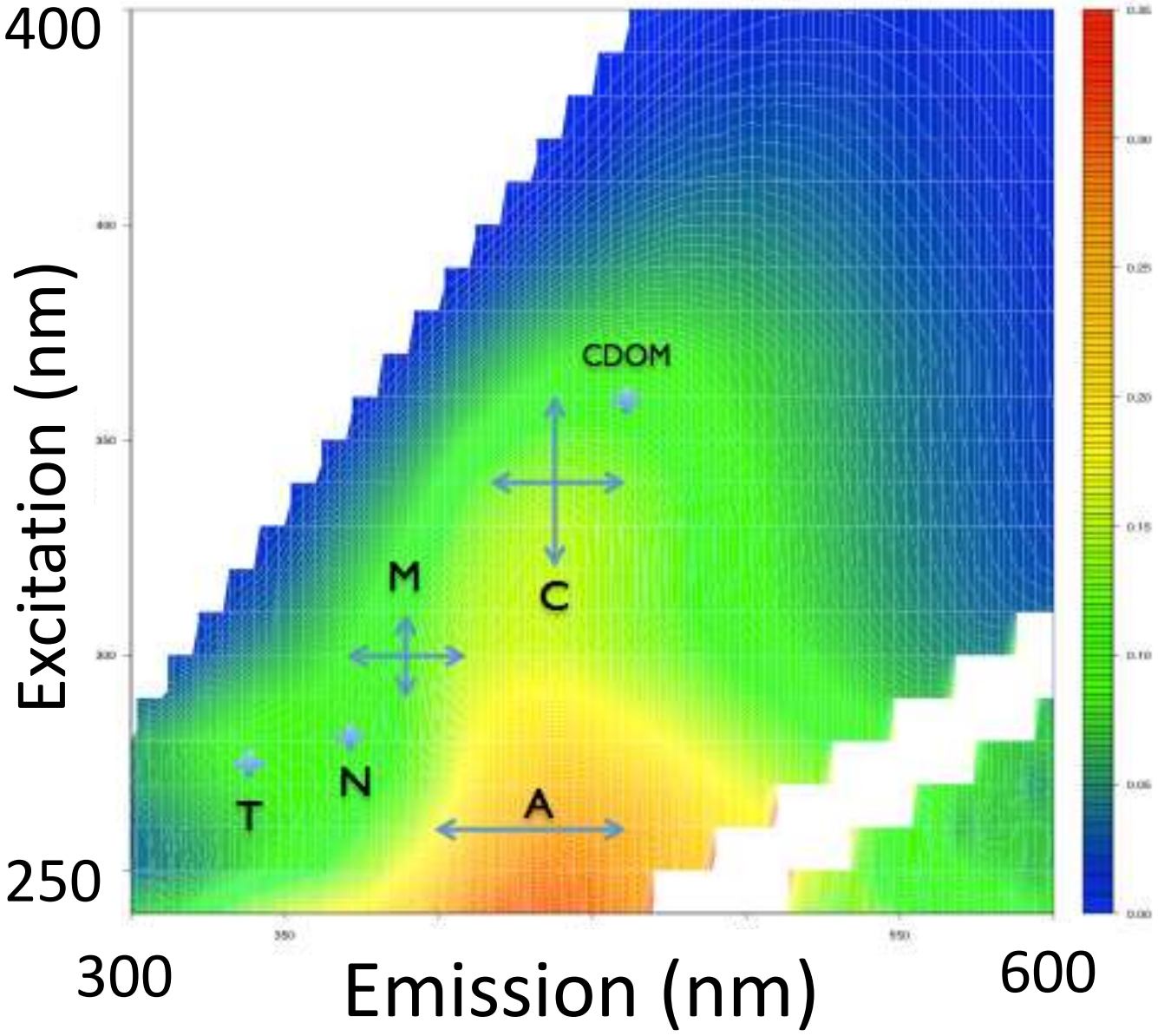


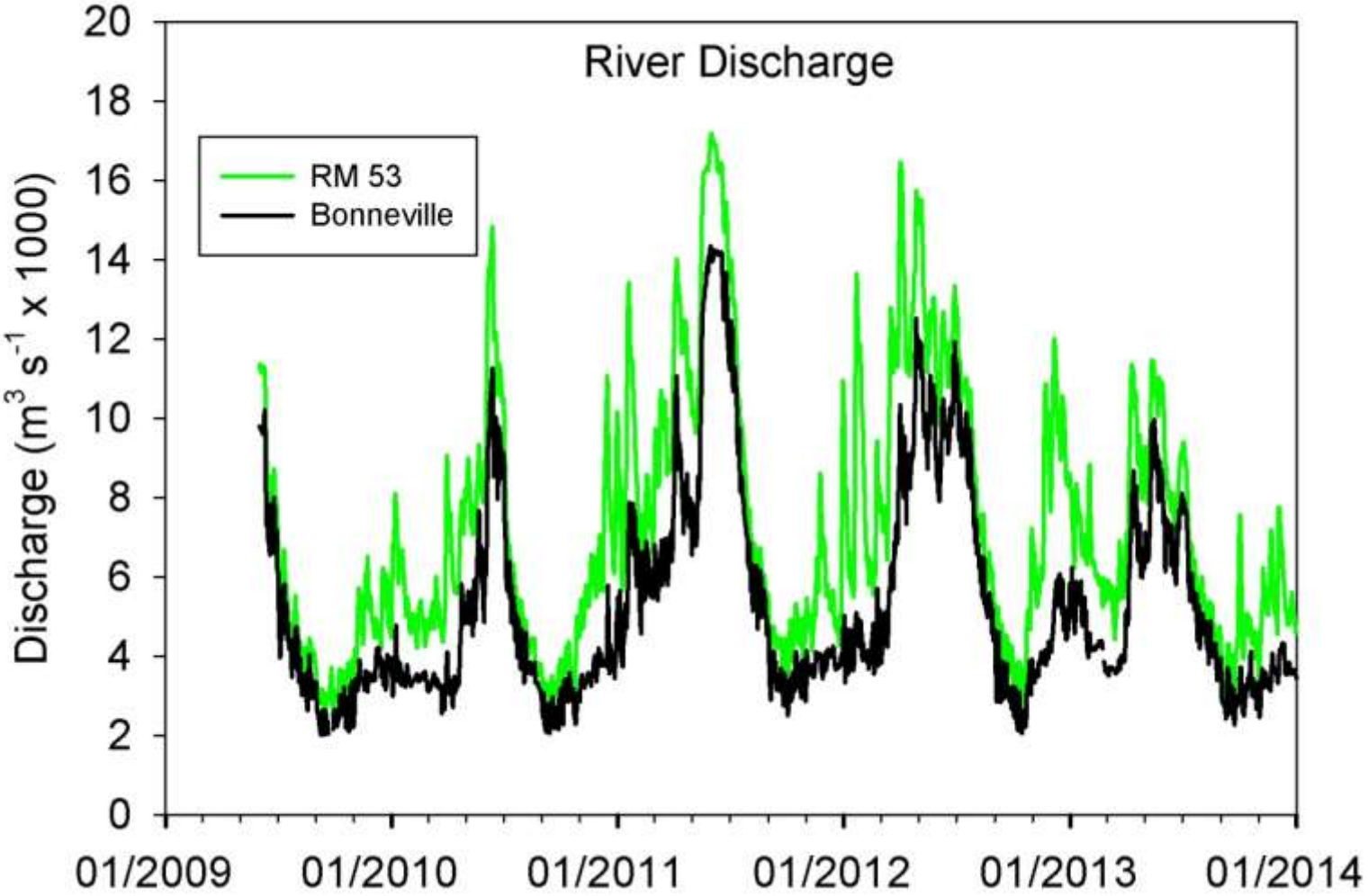
CMOP
Center for Coastal Margin Observation & Prediction

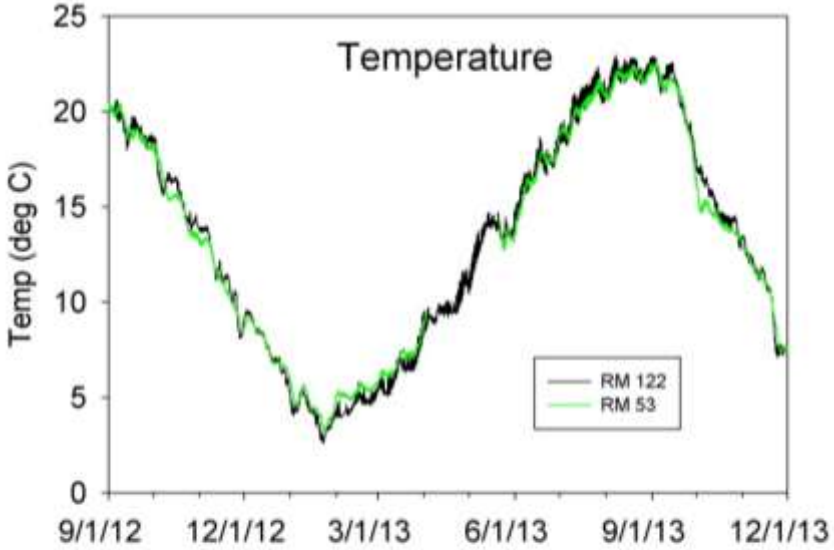
LOBO Land/Ocean Biogeochemical C

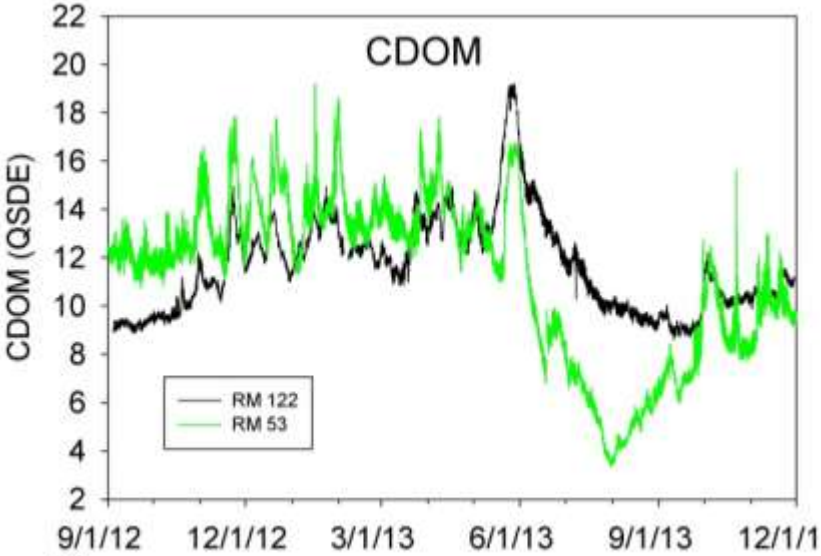


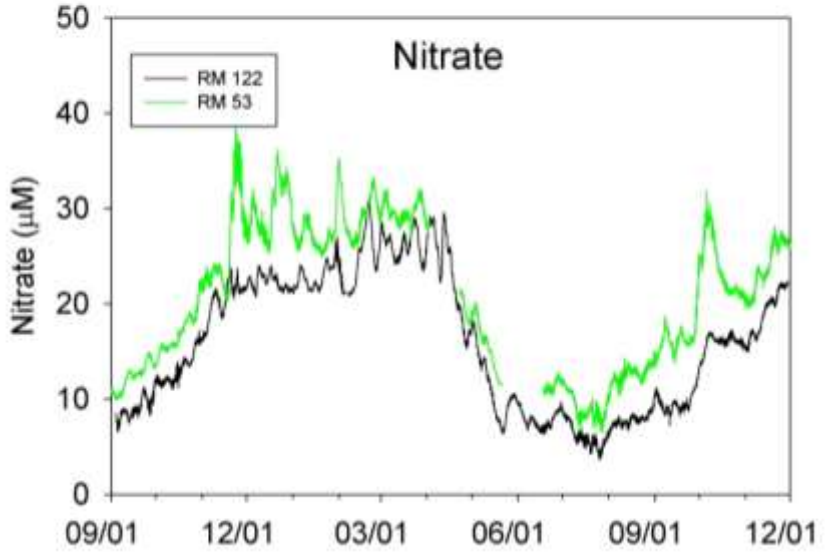
CDOM sensor

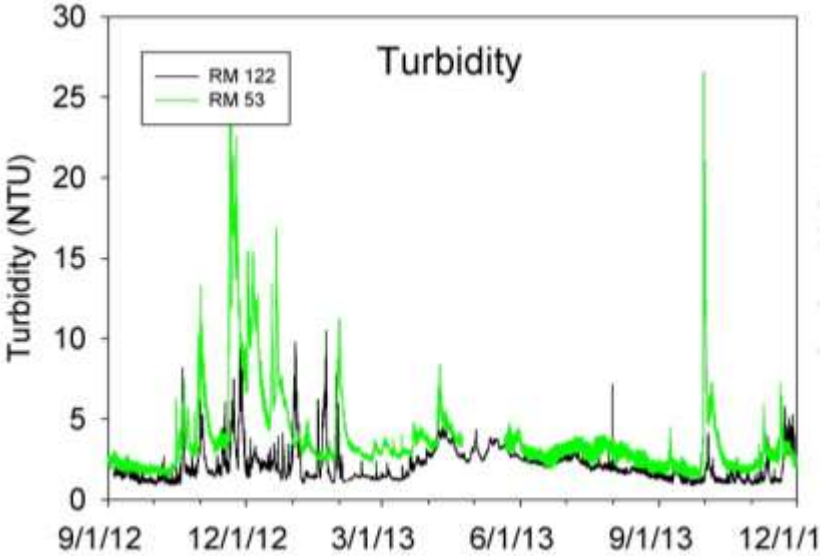


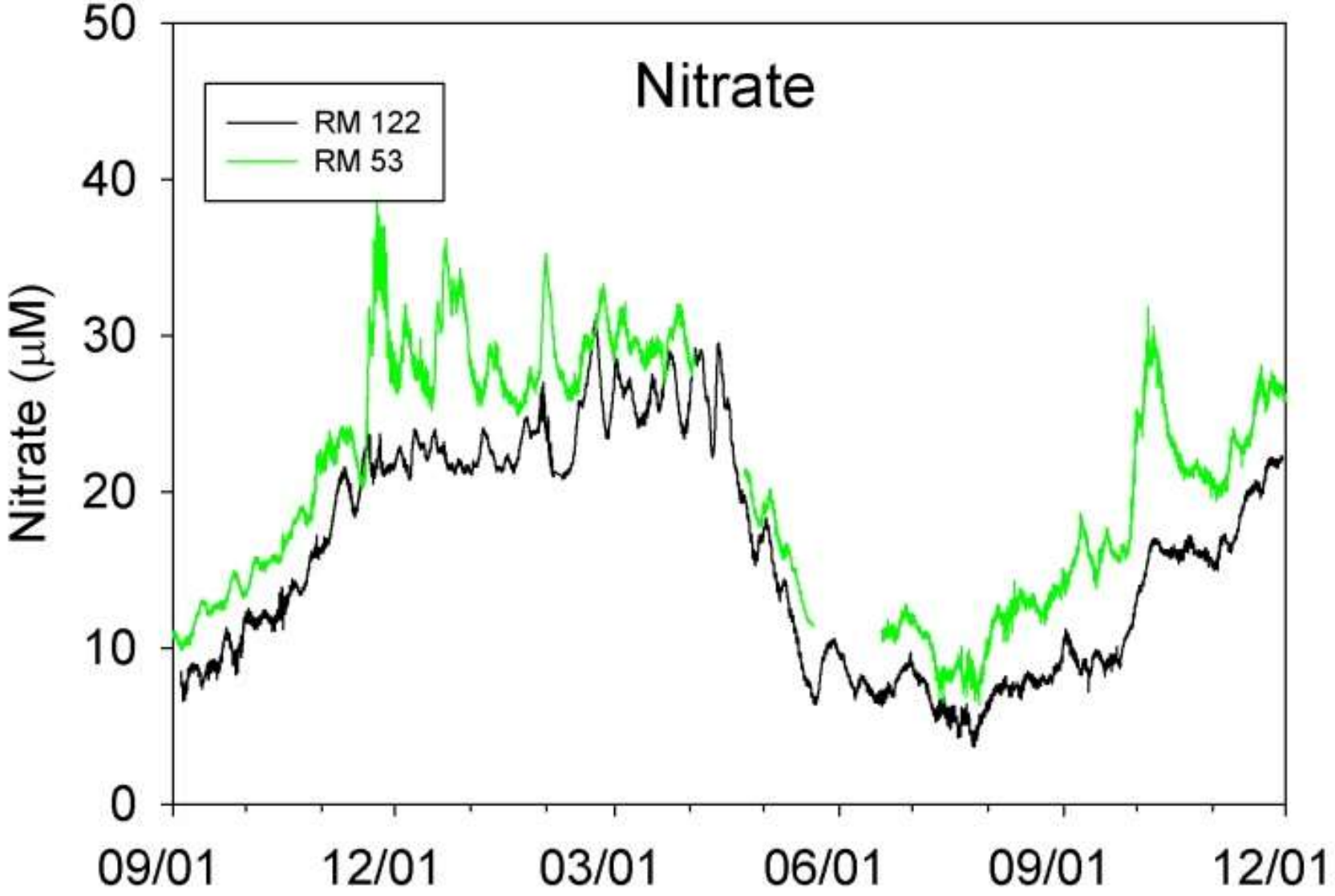

River Discharge
RM 53
Bonneville
Discharge (m3 s-1 x 1000)
0
2
4
6
8
10
12
14
16
18
20
01/2009
01/2010
01/2011
01/2012
01/2013
01/2014

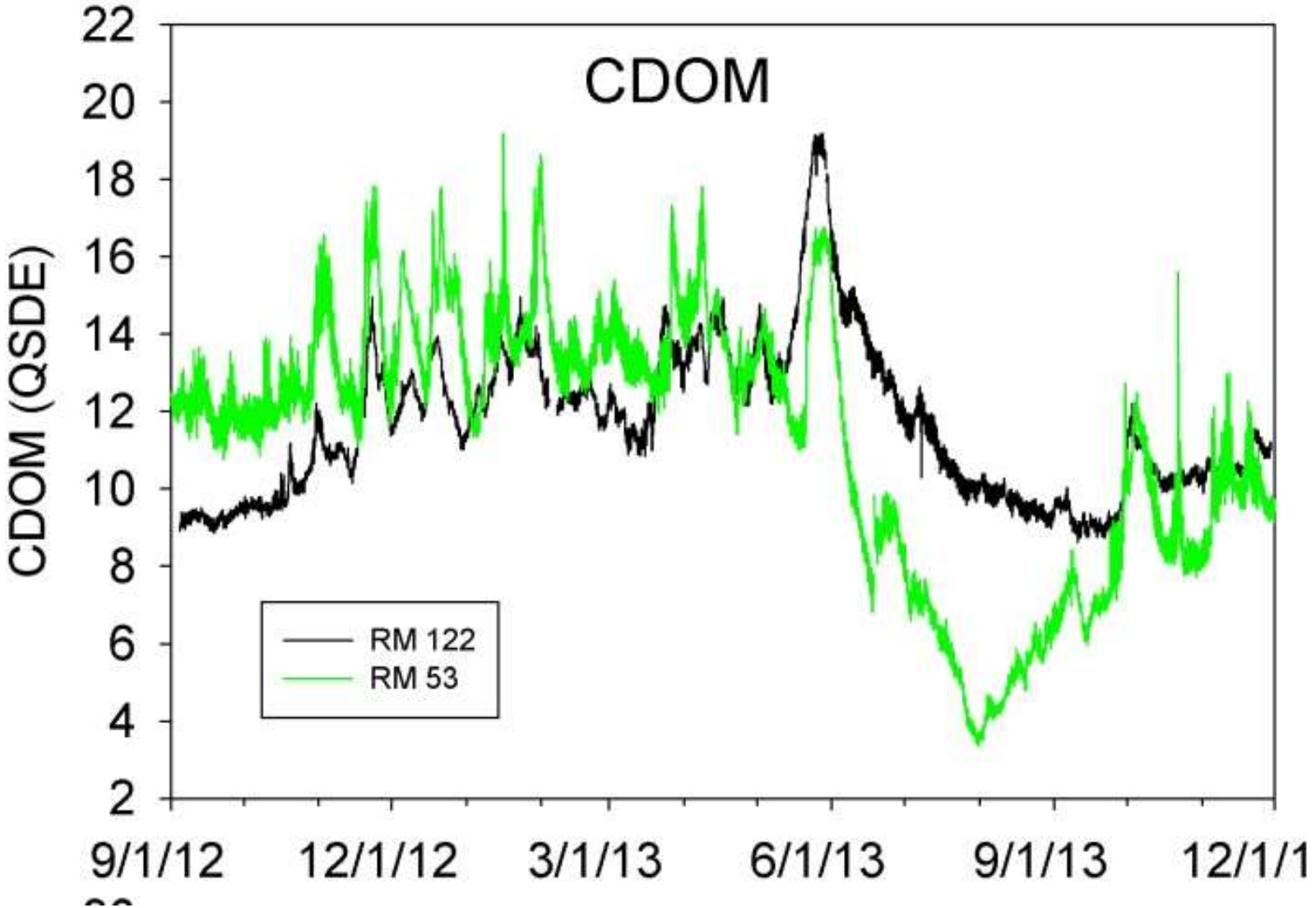

Temperature
Temp (deg C)
25
20
15
10
5
0
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13
RM 122
RM 53

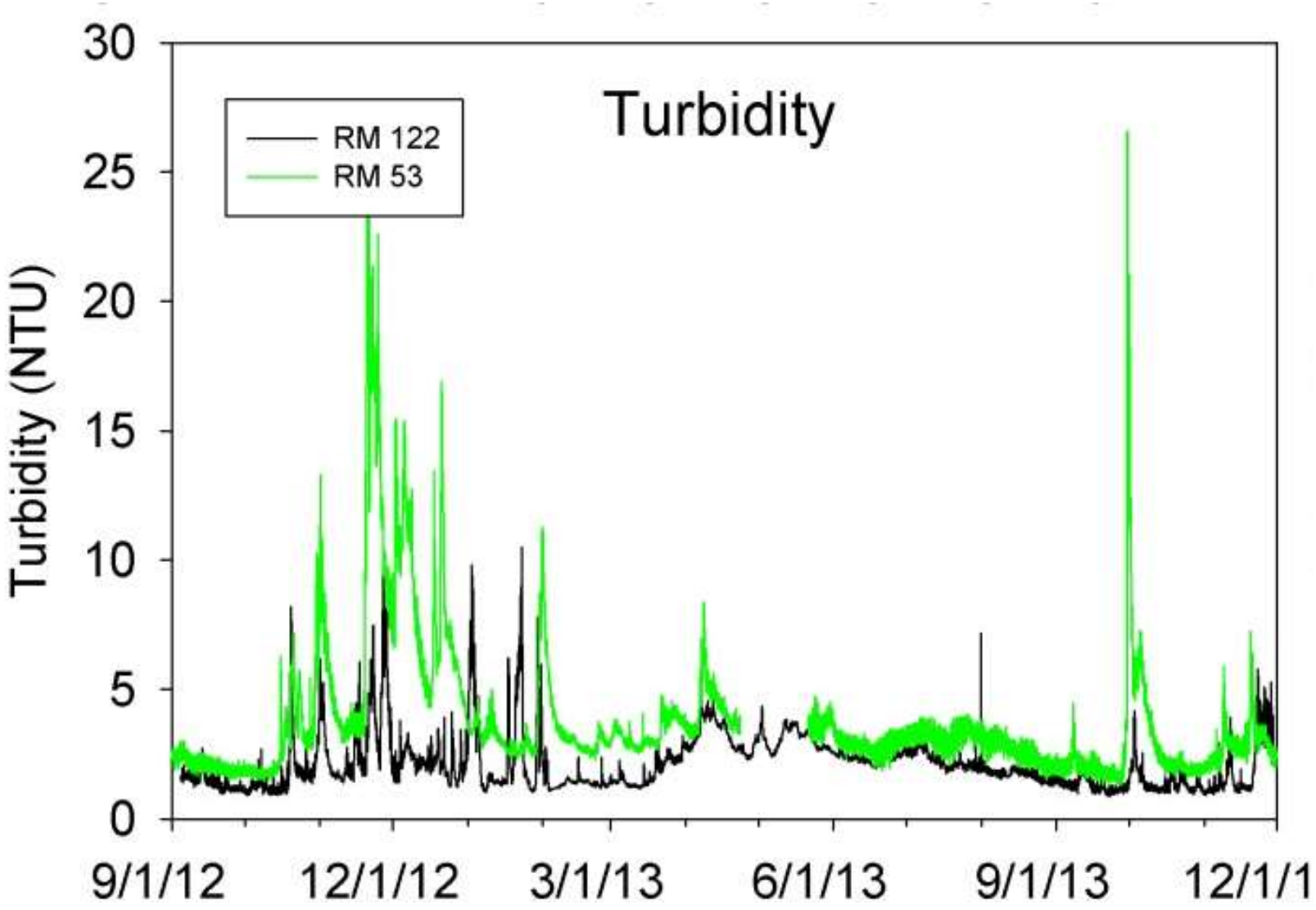

CDOM
CDOM (QSDE)
22
20
18
16
14
12
10
8
6
4
2
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/1
RM 122
RM 53

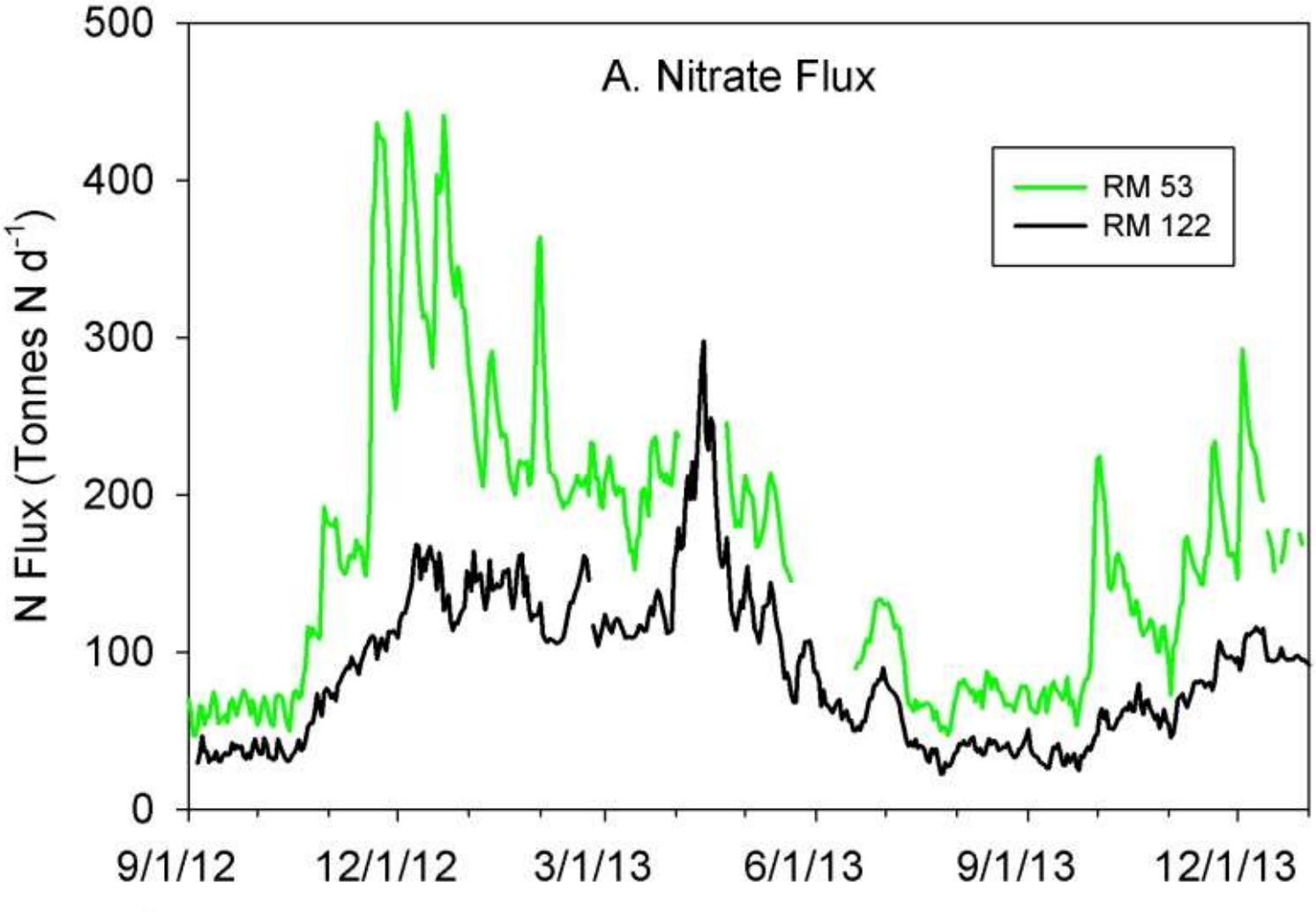

Nitrate
Nitrate (µM)
50
40
30
20
10
0
09/01
12/01
03/01
06/01
09/01
12/01
RM 122
RM 53

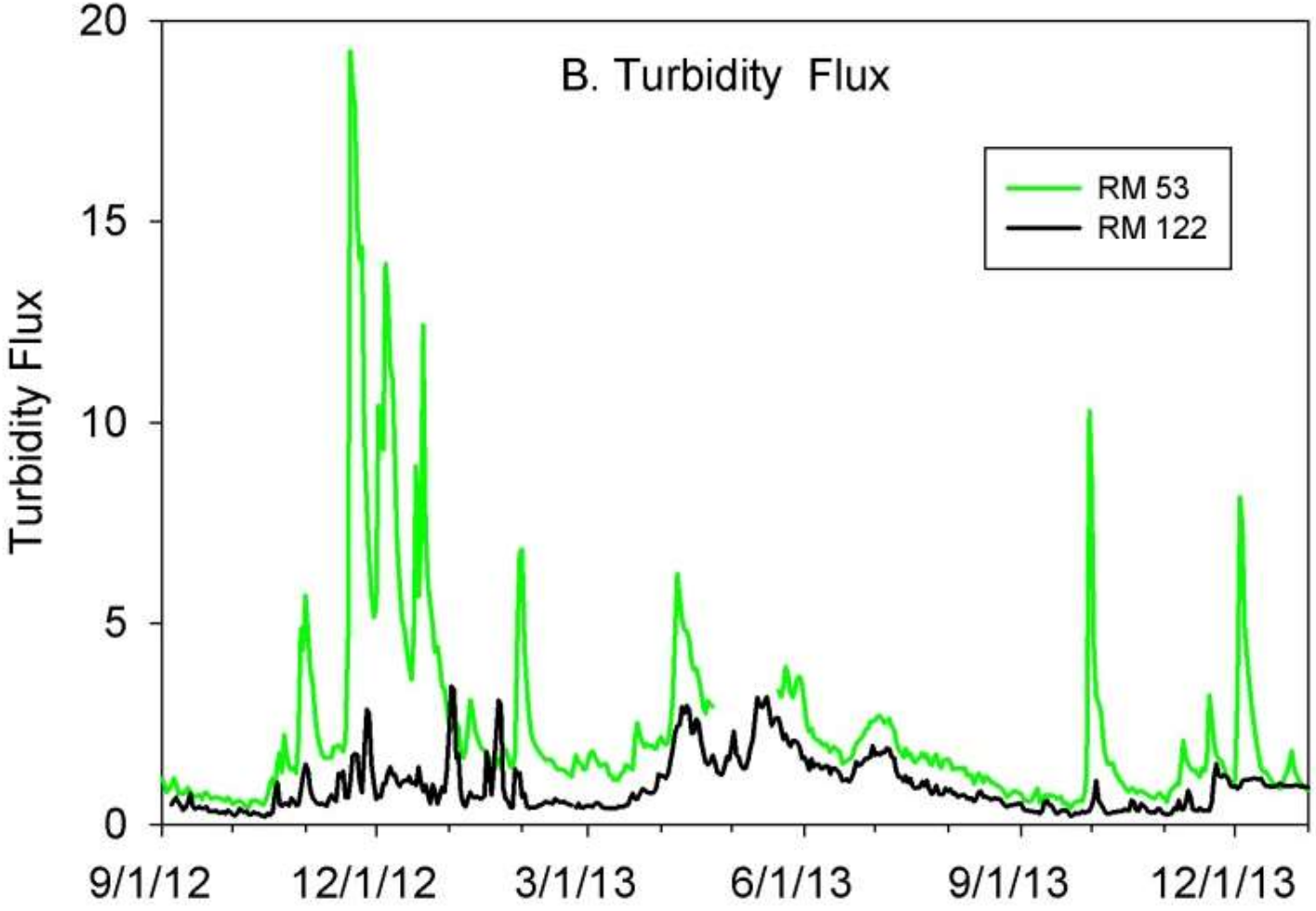

Turbidity
Turbidity (NTU)
30
25
20
15
10
5
0
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/1
RM 122
RM 53

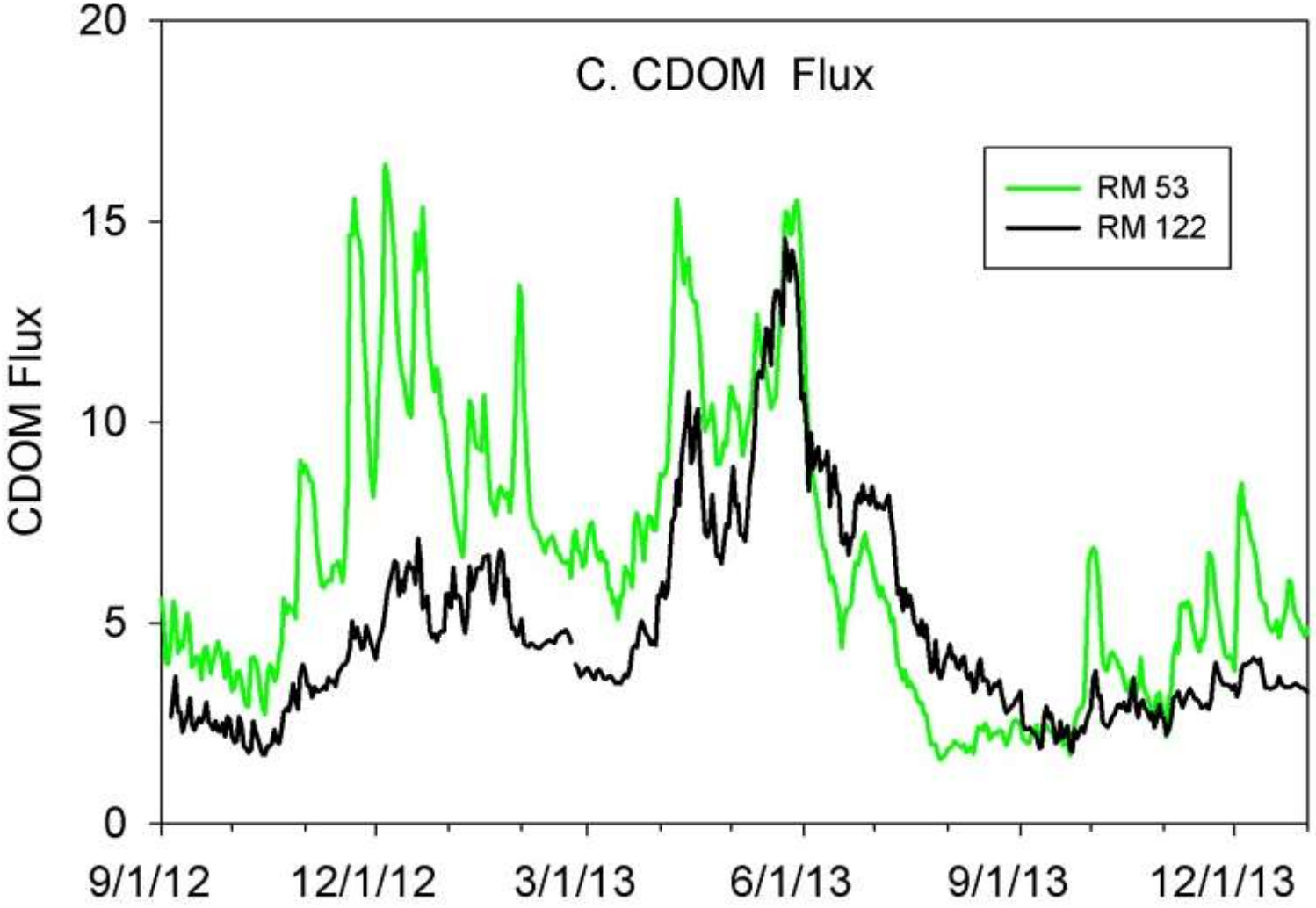

Nitrate
RM 122
RM 53
Nitrate (µM)
50
40
30
20
10
0
09/01
12/01
03/01
06/01
09/01
12/01


CDOM
CDOM (QSDE)
22
20
18
16
14
12
10
8
6
4
2
RM 122
RM 53
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/1

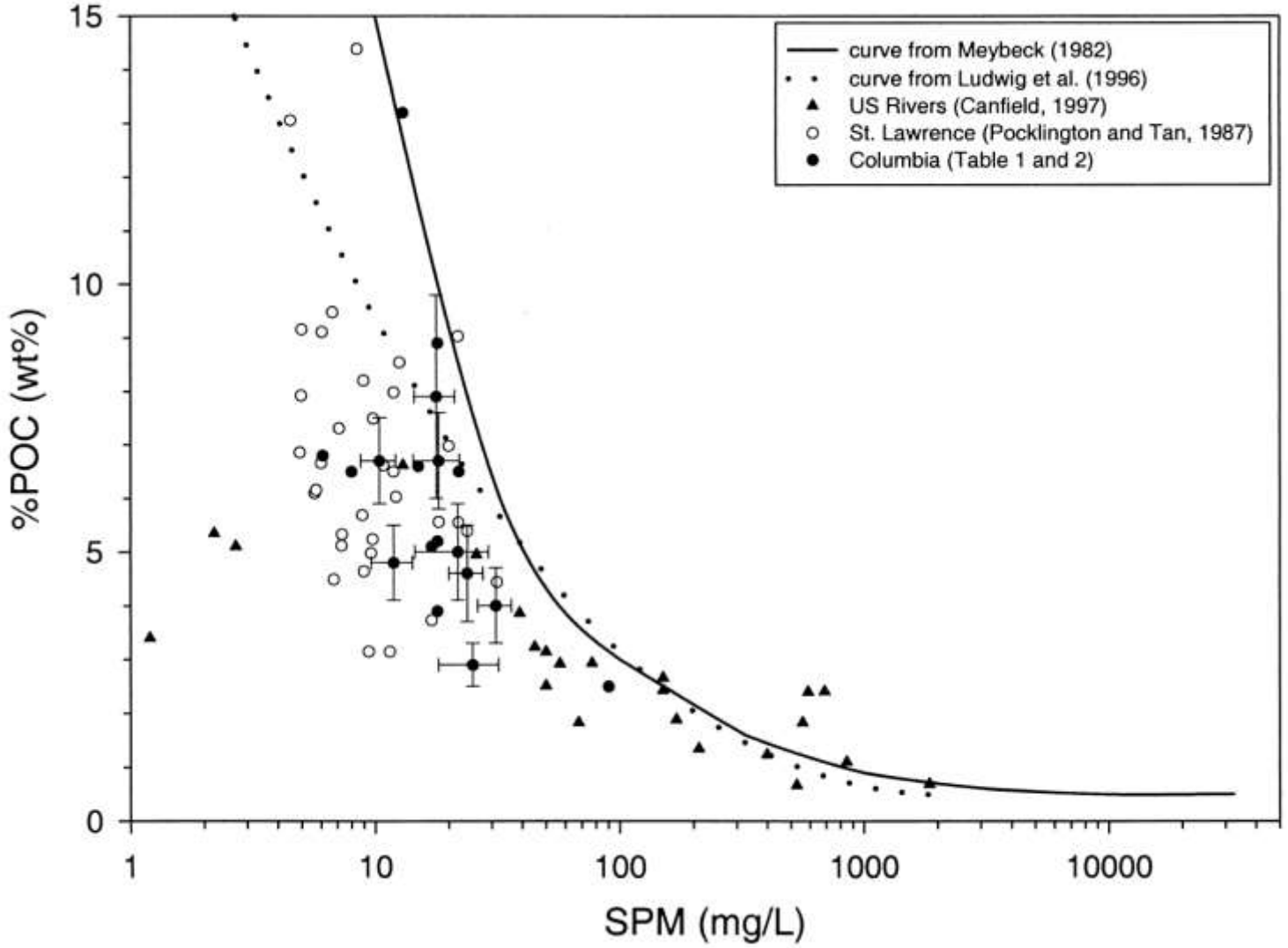

Turbidity
RM 122
RM 53
Turbidity (NTU)
30
25
20
15
10
5
0
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/1


A. Nitrate Flux
N Flux (Tonnes N d-1)
500
400
300
200
100
0
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13
RM 53
RM 122

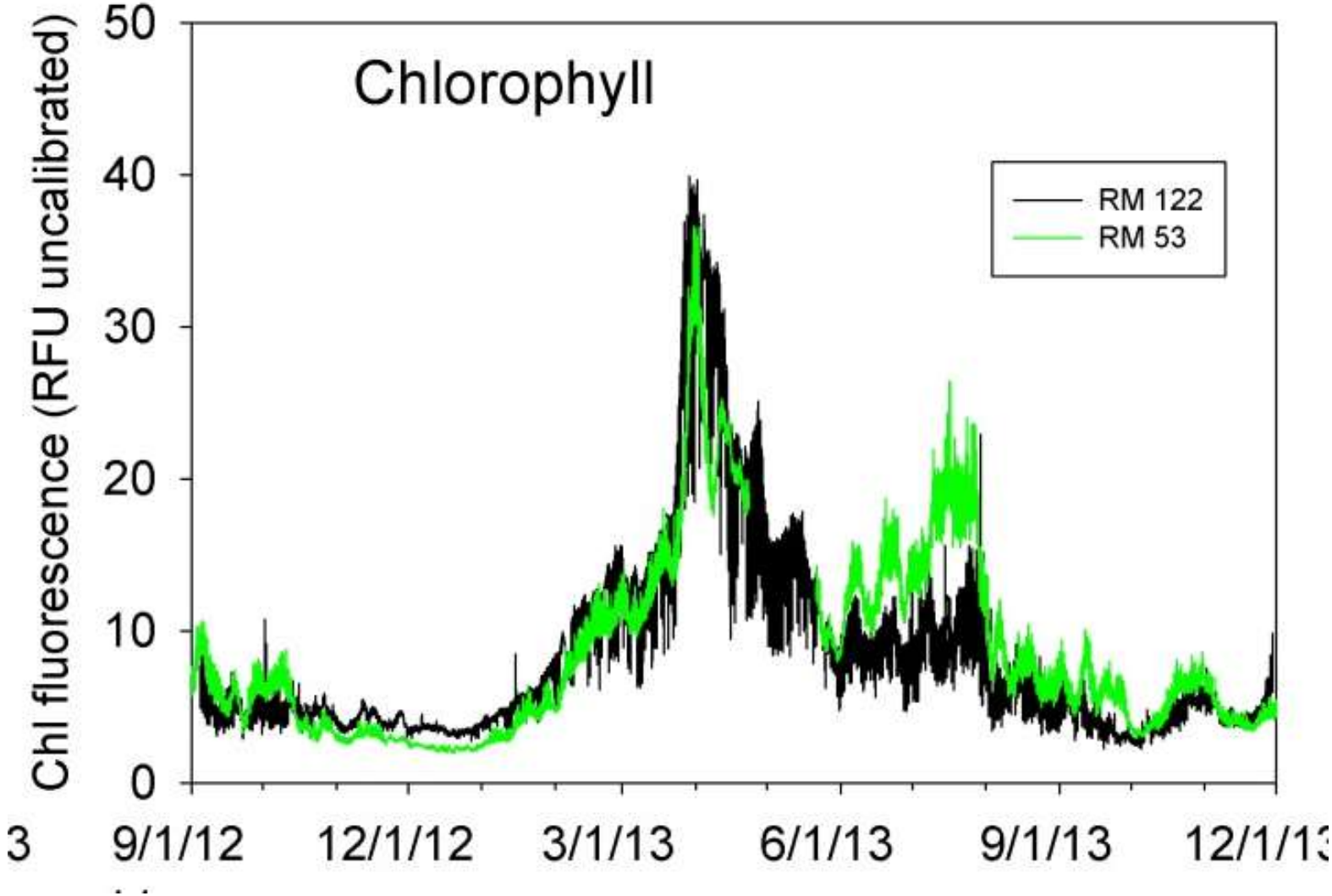

B. Turbidity Flux
Turbidity Flux
20
15
10
5
0
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13
RM 53
RM 122


C. CDOM Flux
CDOM Flux
20
15
10
5
0
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13
RM 53
RM 122

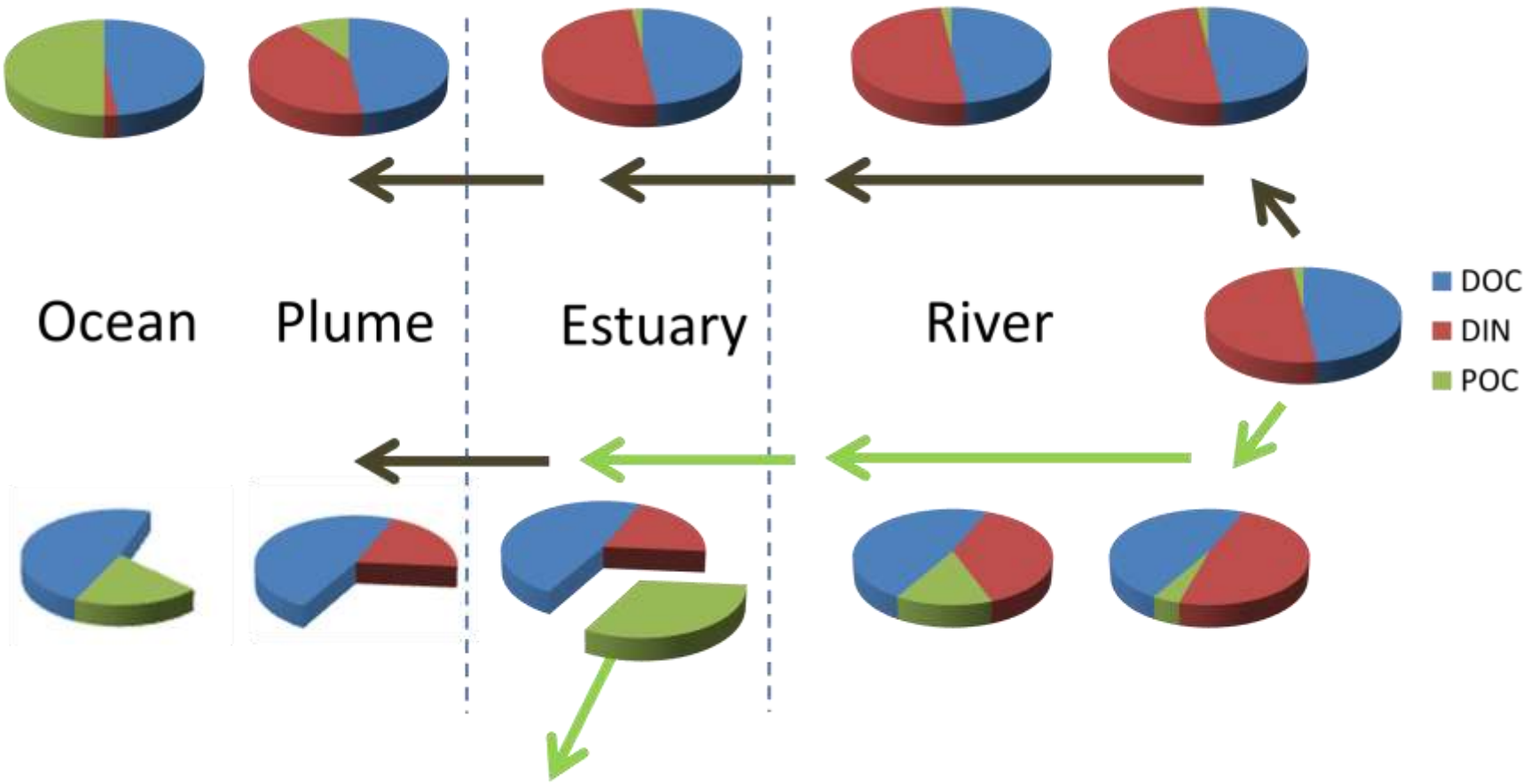
‘Greening’ of the Columbia River

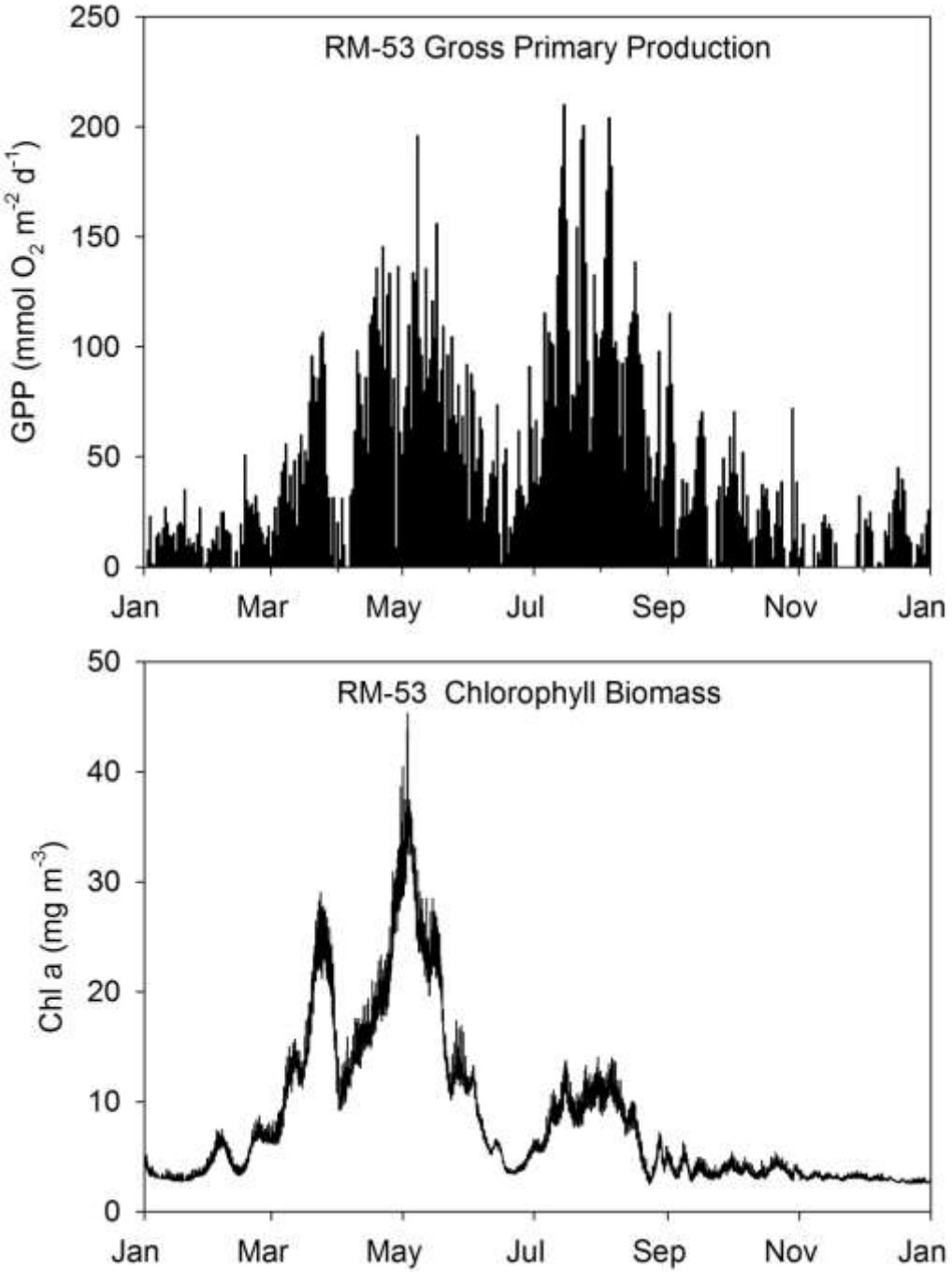


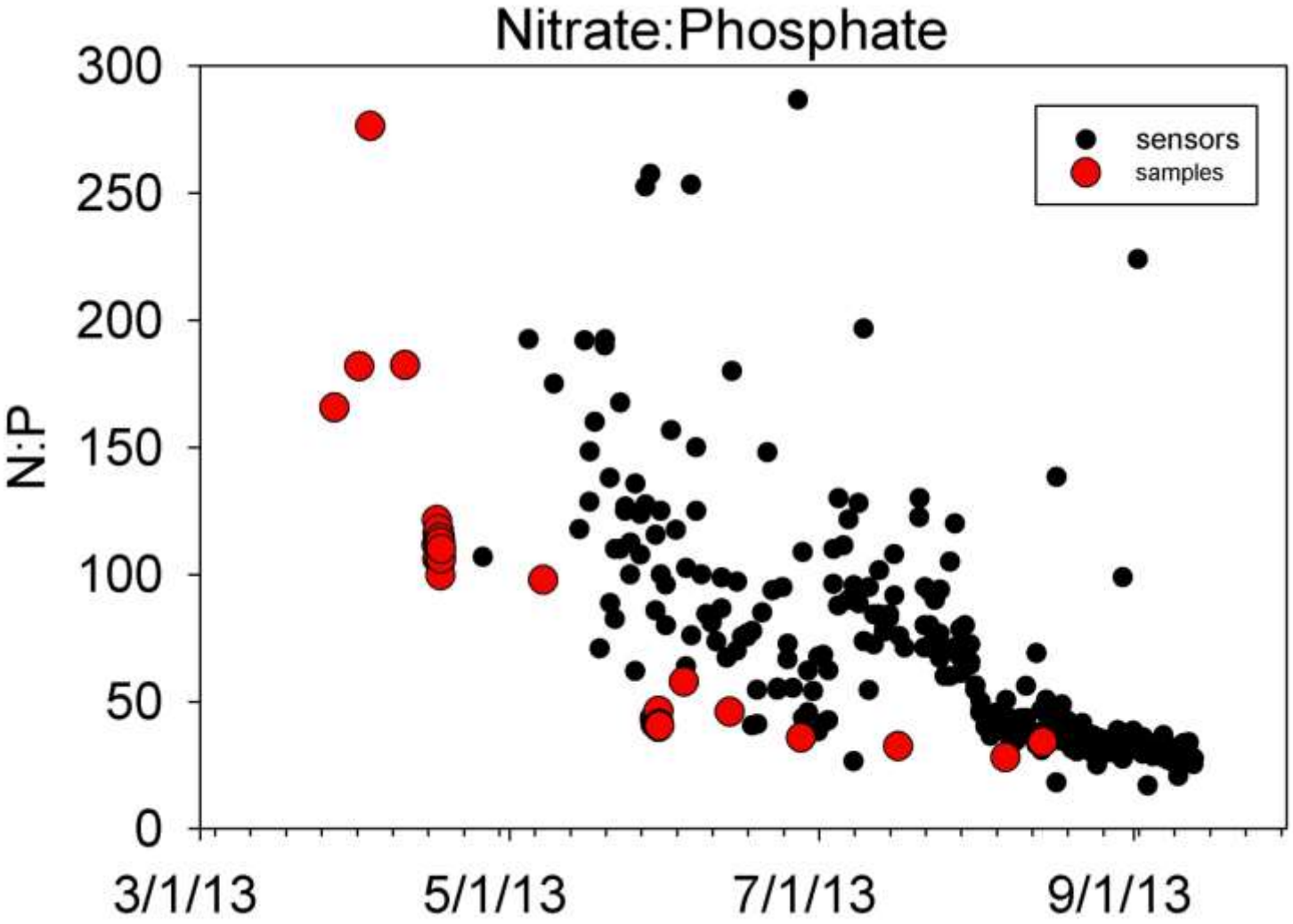
Sullivan et al. 2001

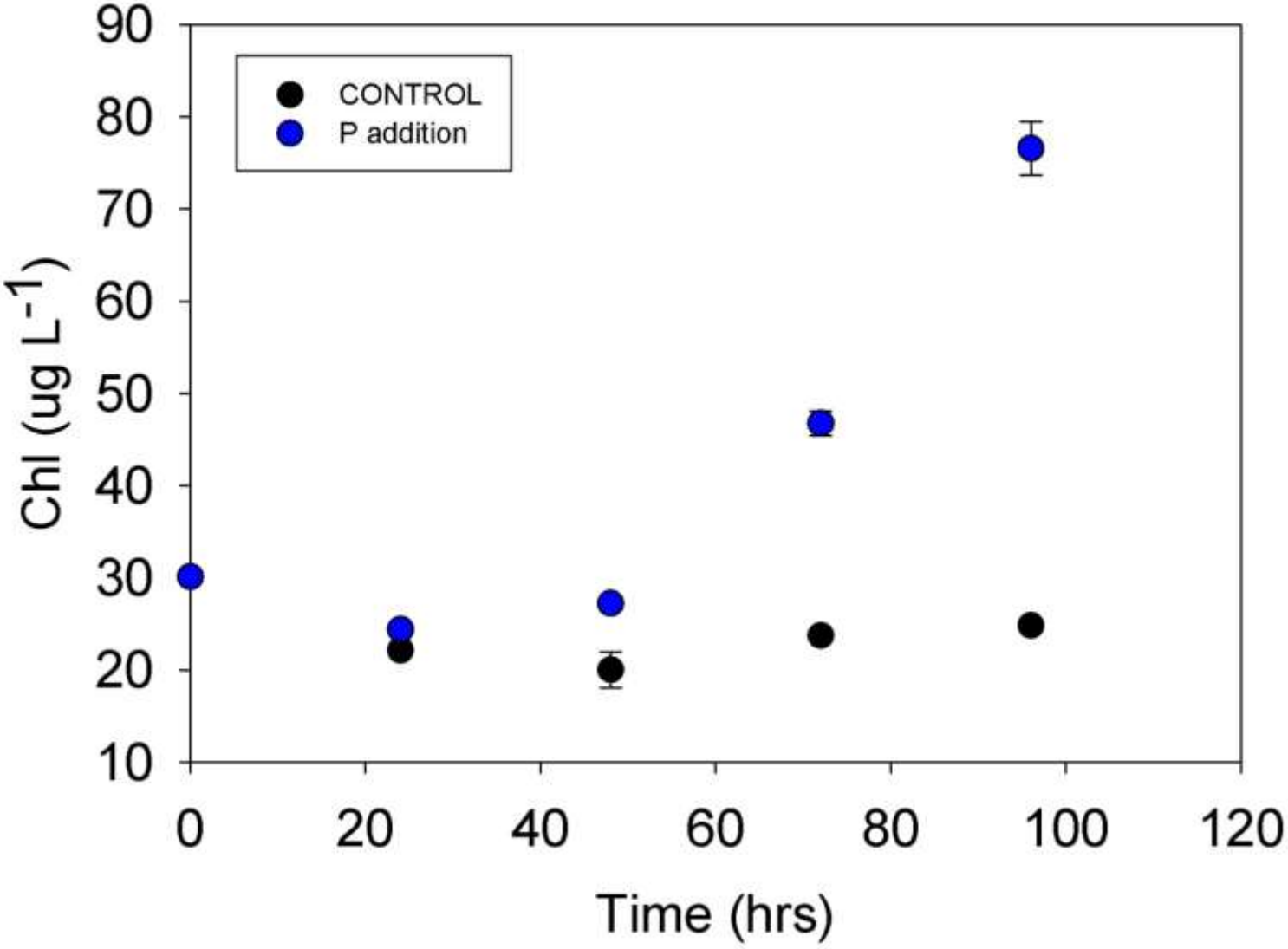

Chlorophyll
Chl fluorescence (RFU uncalibrated)
50
40
30
20
10
0
RM 122
RM 53
3
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13

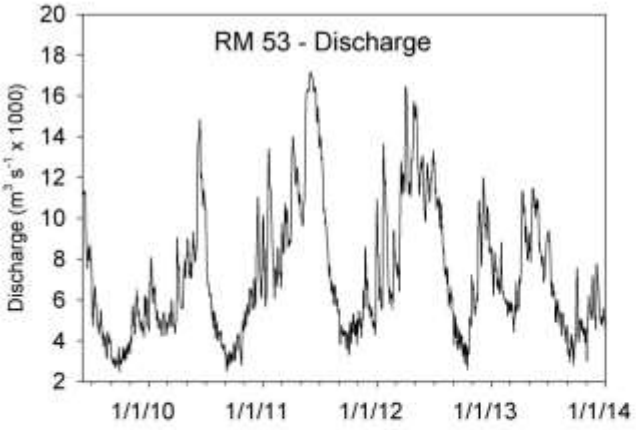
Green vs Brown River

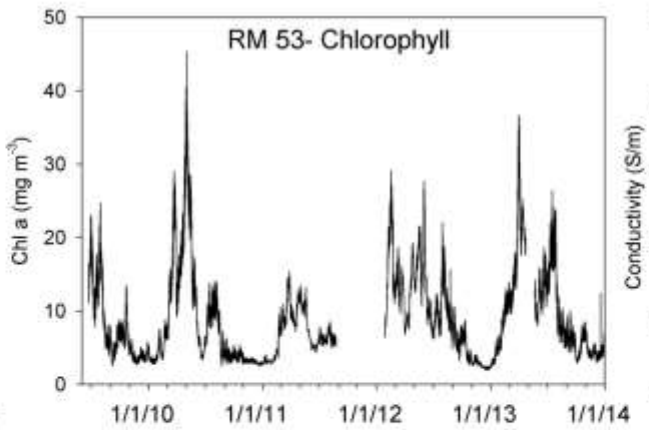


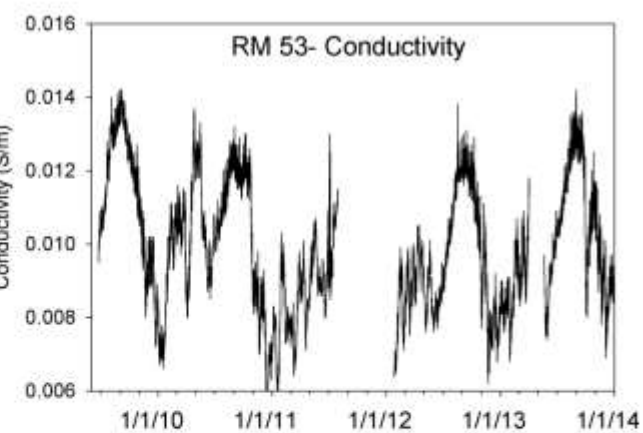

RM-53 Gross Primary Production
GPP (mmol O2 m-2 d-1)
250
200
150
100
50
0
Jan
Mar
May
Jul
Sep
Nov
Jan
RM-53 Chlorophyll Biomass
Chl a (mg m-3)
50
40
30
20
10
0
Jan
Mar
May
Jul
Sep
Nov
Jan

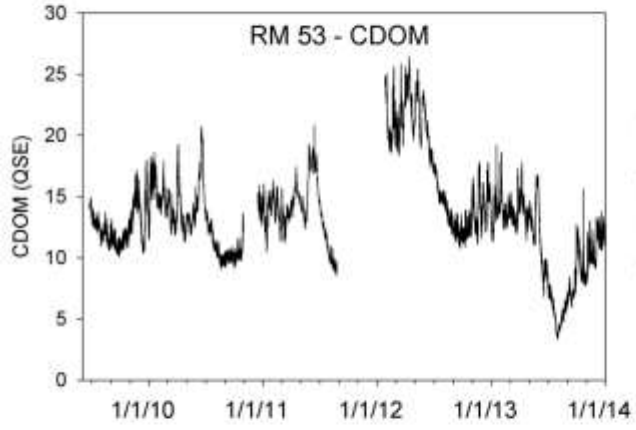

Nitrate:Phosphate
N:P
300
250
200
150
100
50
0
3/1/13
5/1/13
7/1/13
9/1/13
sensors
samples

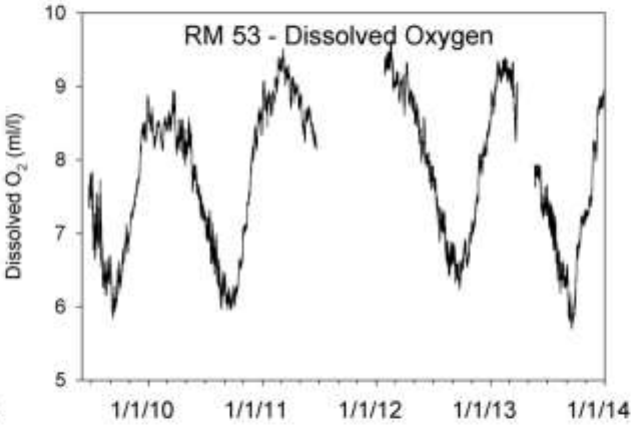

CONTROL
P addition
Chl (ug L-1)
Time (hrs)
90
80
70
60
50
40
30
20
10
0
20
40
60
80
100
120

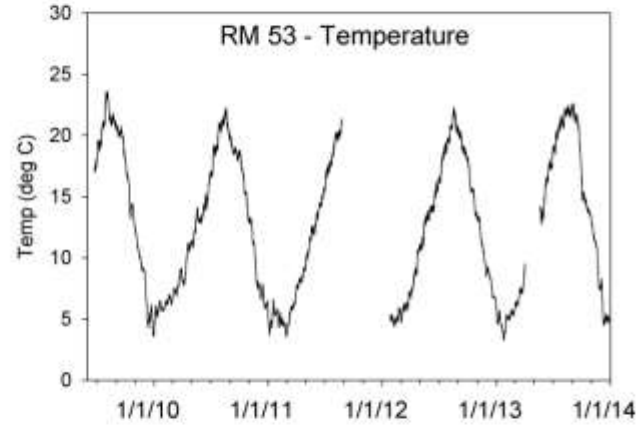

RM 53 - Discharge
Discharge ($m^3 s^{-1}$ x 1000)
20
18
16
14
12
10
8
6
4
2
1/1/10
1/1/11
1/1/12
1/1/13
1/1/14

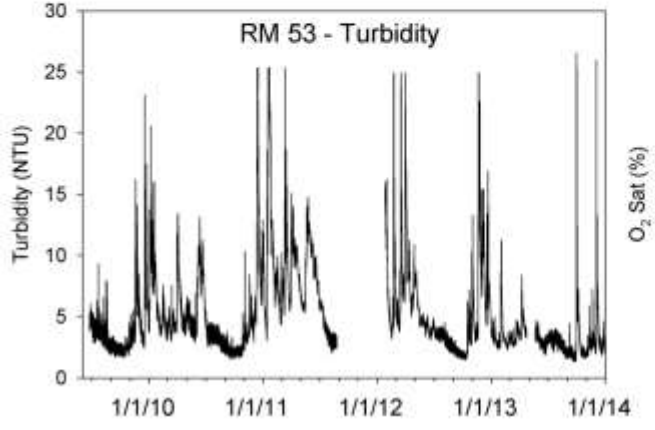

RM 53- Chlorophyll
Chl a (mg m^{-3})
50
40
30
20
10
0
1/1/10
1/1/11
1/1/12
1/1/13
1/1/14

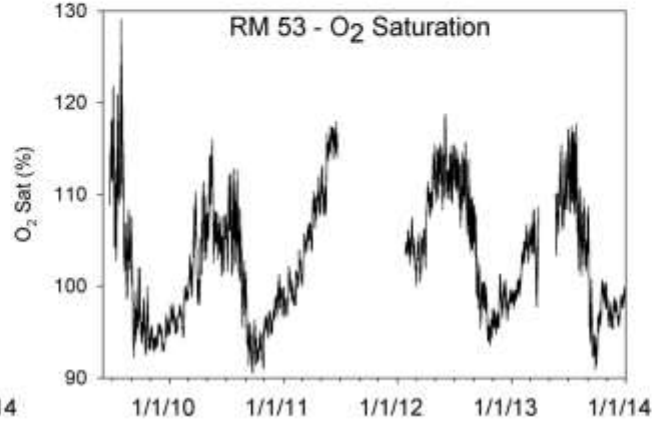

RM 53- Conductivity
Conductivity (S/m)
0.016
0.014
0.012
0.010
0.008
0.006
1/1/10
1/1/11
1/1/12
1/1/13
1/1/14

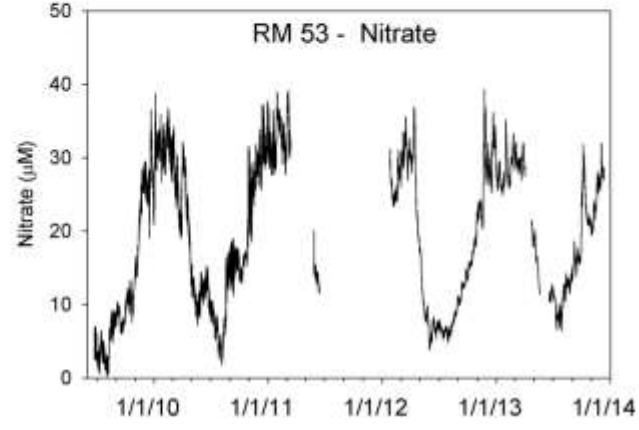

RM 53 - CDOM
CDOM (QSE)
30
25
20
15
10
5
0
1/1/10
1/1/11
1/1/12
1/1/13
1/1/14

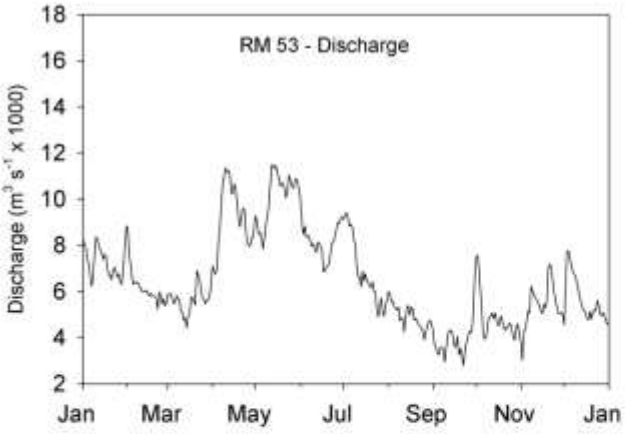

RM 53 - Dissolved Oxygen
Dissolved O_2 (ml/l)
10
9
8
7
6
5
1/1/10
1/1/11
1/1/12
1/1/13
1/1/14

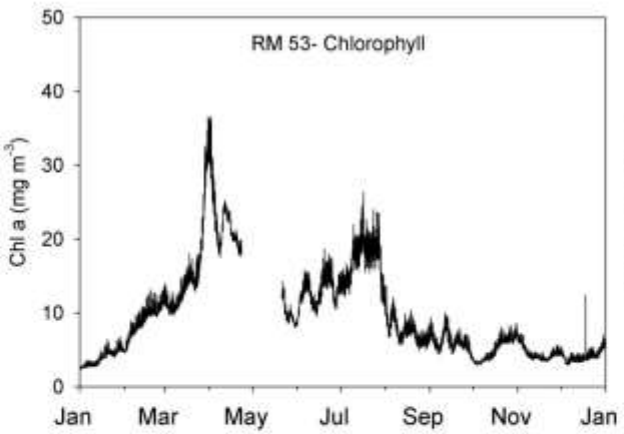

RM 53 - Temperature
Temp (deg C)
30
25
20
15
10
5
0
1/1/10
1/1/11
1/1/12
1/1/13
1/1/14

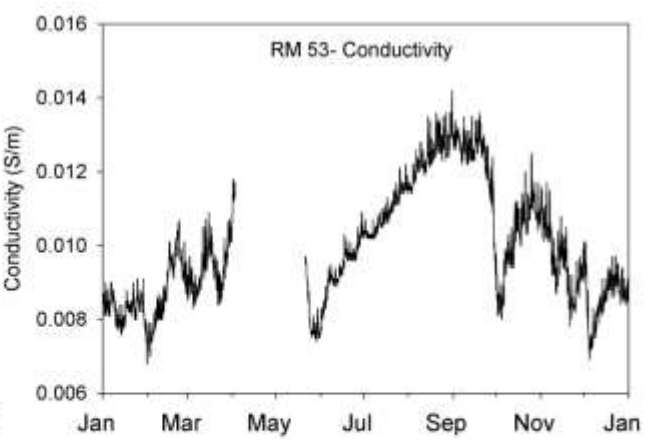

RM 53 - Turbidity
Turbidity (NTU)
30
25
20
15
10
5
0
1/1/10
1/1/11
1/1/12
1/1/13
1/1/14

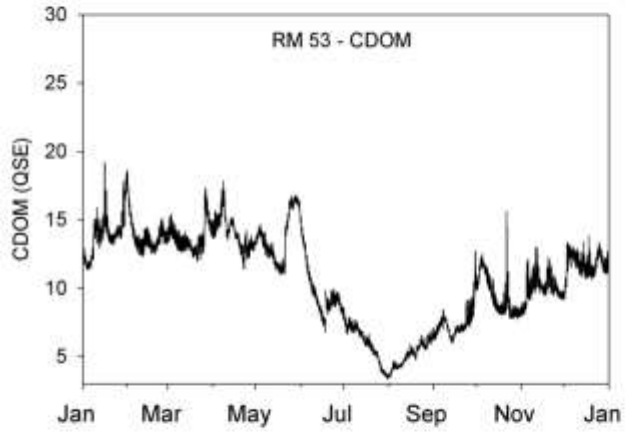

RM 53 - O_2 Saturation
O_2 Sat (%)
130
120
110
100
90
1/1/10
1/1/11
1/1/12
1/1/13
1/1/14

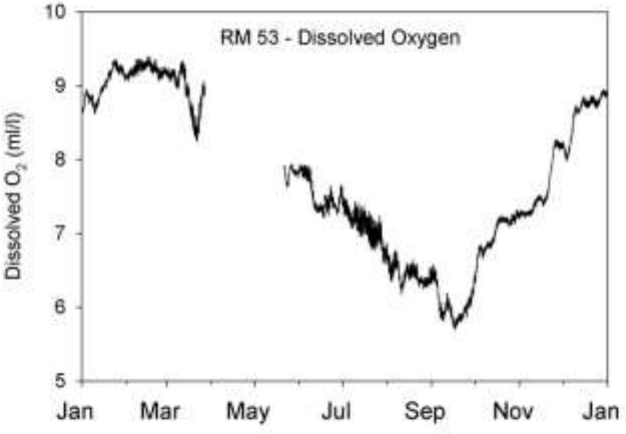

RM 53 - Nitrate
Nitrate (µM)
50
40
30
20
10
0
1/1/10
1/1/11
1/1/12
1/1/13
1/1/14

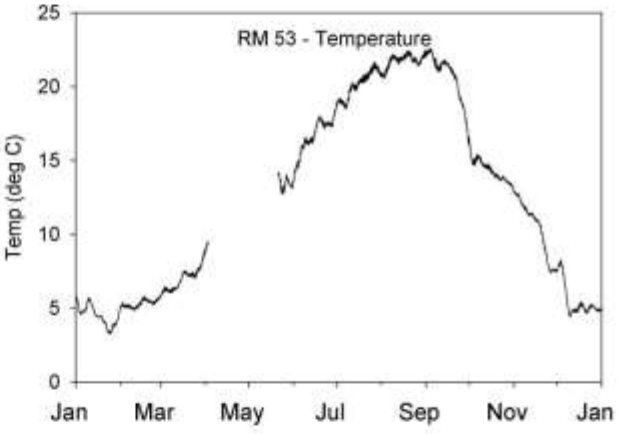

RM 53 - Discharge
Discharge (m3 s-1 x 1000)
18
16
14
12
10
8
6
4
2
Jan
Mar
May
Jul
Sep
Nov
Jan

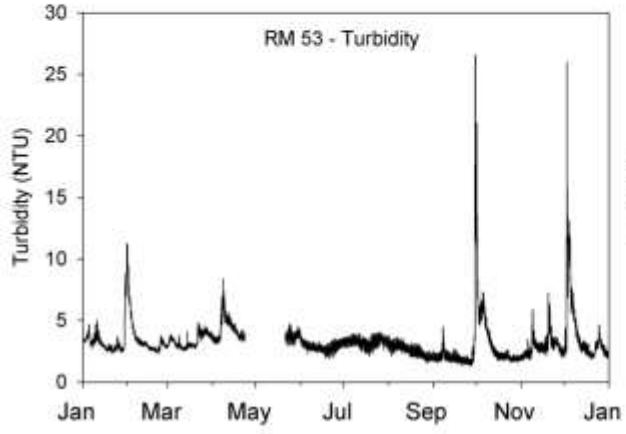

RM 53- Chlorophyll
Chl a (mg m-3)
50
40
30
20
10
0
Jan
Mar
May
Jul
Sep
Nov
Jan

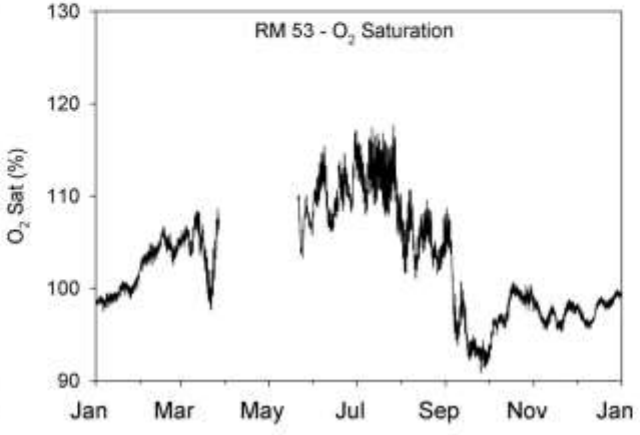

RM 53- Conductivity
Conductivity (S/m)
0.016
0.014
0.012
0.010
0.008
0.006
Jan
Mar
May
Jul
Sep
Nov
Jan

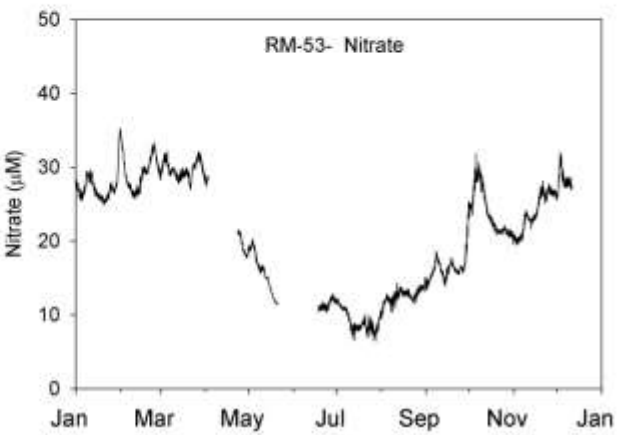

RM 53 - CDOM
CDOM (QSE)
30
25
20
15
10
5
Jan
Mar
May
Jul
Sep
Nov
Jan

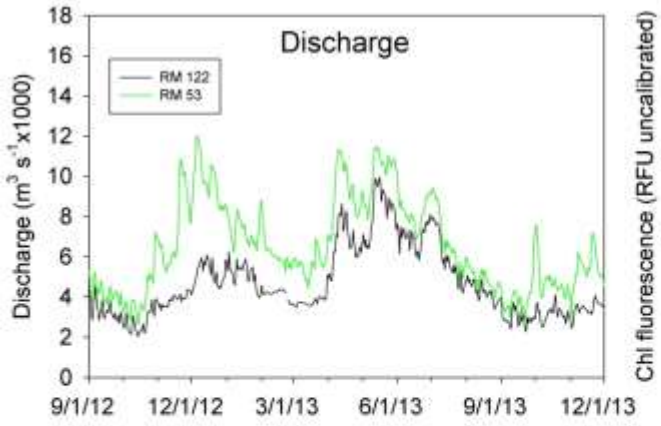

RM 53 - Dissolved Oxygen
Dissolved O2 (ml/l)
10
9
8
7
6
5
Jan
Mar
May
Jul
Sep
Nov
Jan

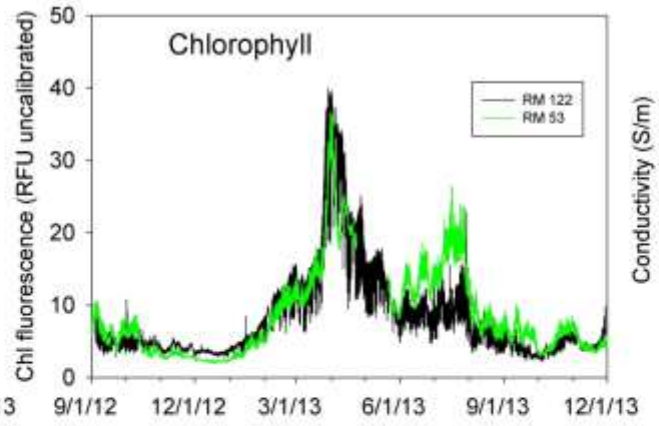

RM 53 - Temperature
Temp (deg C)
25
20
15
10
5
0
Jan
Mar
May
Jul
Sep
Nov
Jan

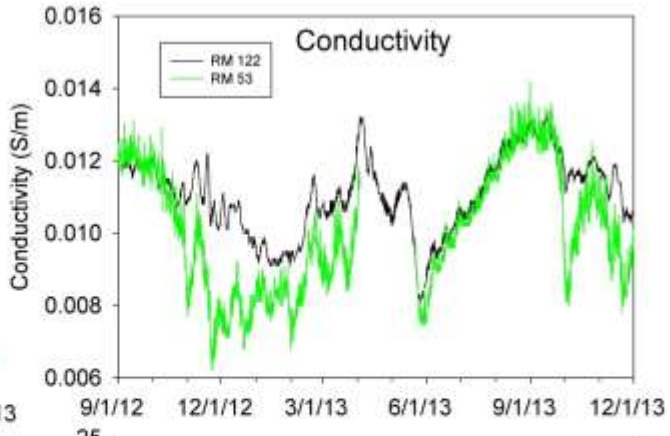

RM 53 - Turbidity
Turbidity (NTU)
30
25
20
15
10
5
0
Jan
Mar
May
Jul
Sep
Nov
Jan

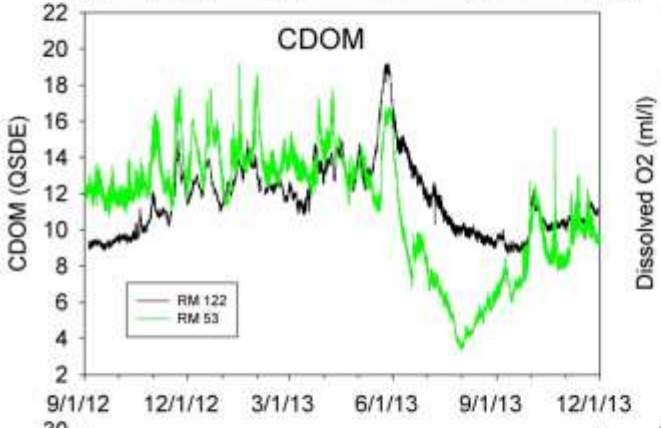

RM 53 - O2 Saturation
O2 Sat (%)
130
120
110
100
90
Jan
Mar
May
Jul
Sep
Nov
Jan


RM-53- Nitrate
Nitrate (µM)
50
40
30
20
10
0
Jan
Mar
May
Jul
Sep
Nov
Jan

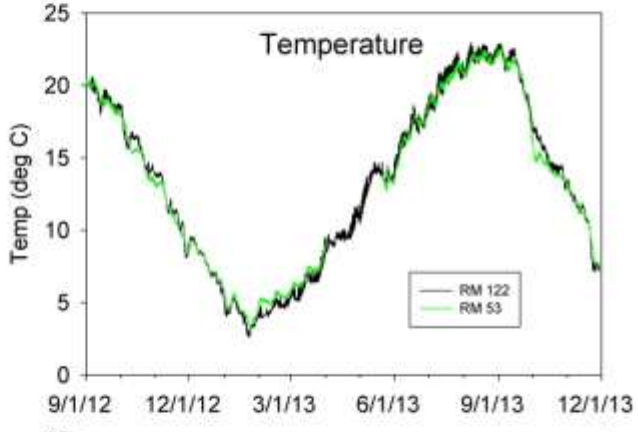

Discharge
Discharge (m3 s-1x1000)
RM 122
RM 53
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13

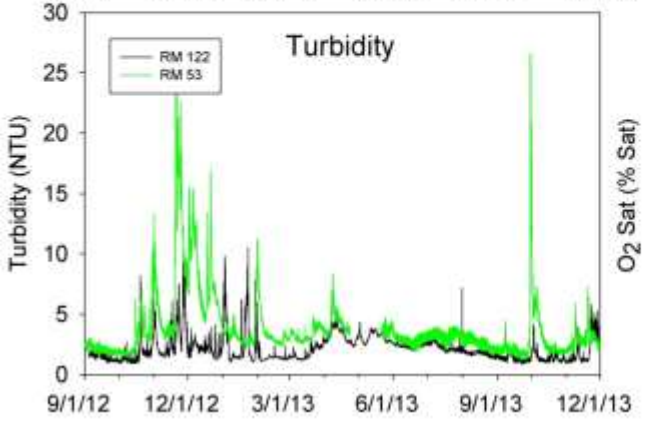

Chlorophyll
Chl fluorescence (RFU uncalibrated)
RM 122
RM 53
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13

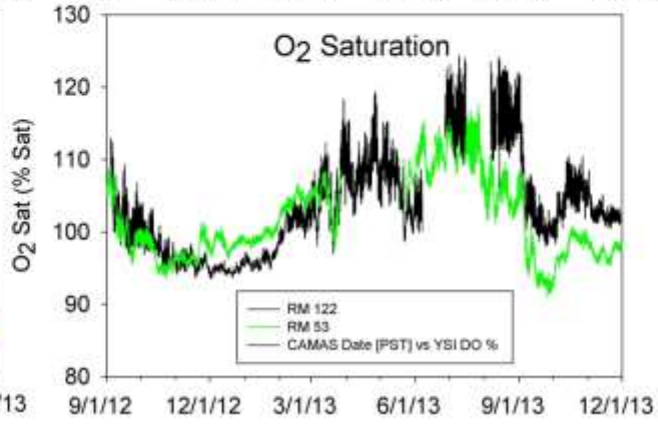

Conductivity
Conductivity (S/m)
RM 122
RM 53
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13

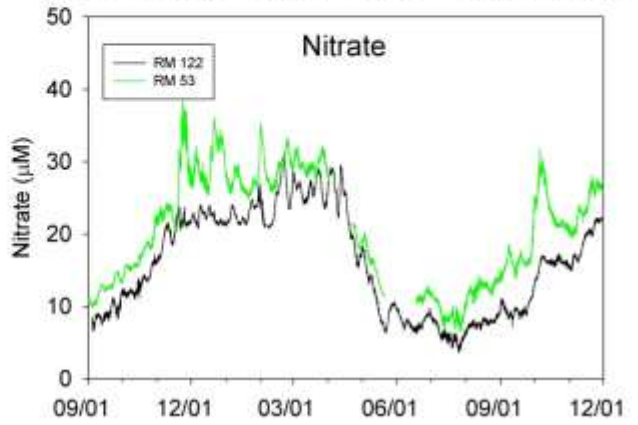

CDOM
CDOM (QSDE)
RM 122
RM 53
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13

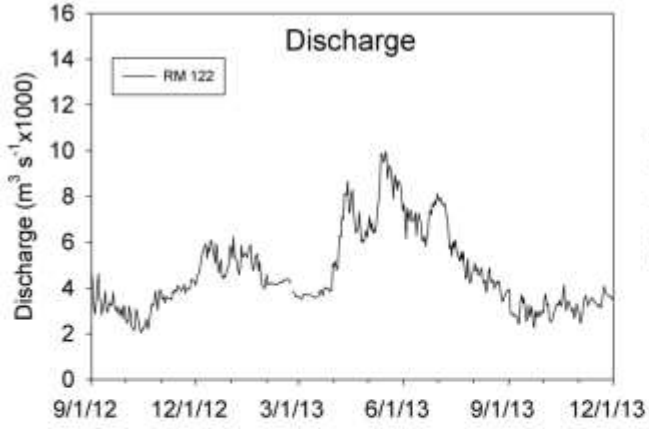

Dissolved Oxygen
Dissolved O2 (ml/l)
RM 122
RM 53
CAMAS Date [PST] vs YSI DO
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13

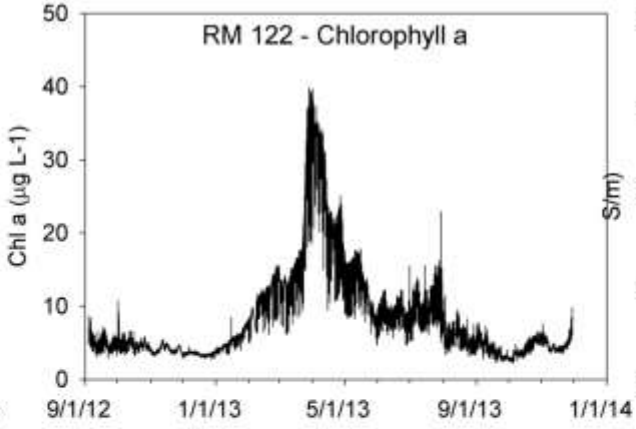

Temperature
Temp (deg C)
RM 122
RM 53
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13

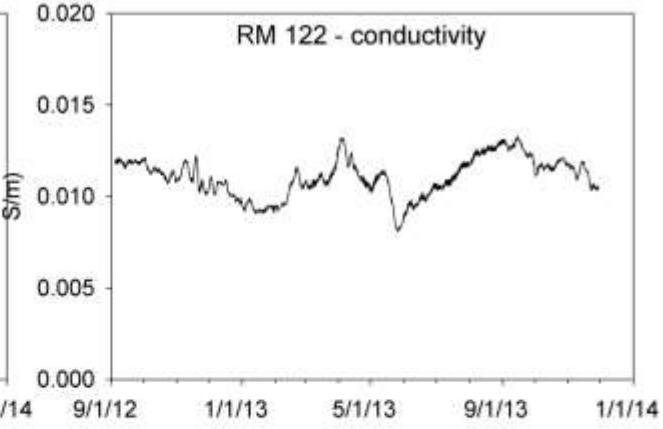

Turbidity
Turbidity (NTU)
RM 122
RM 53
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13

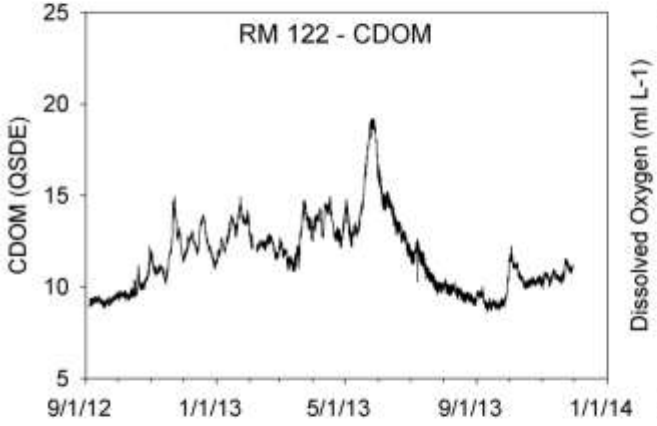

O2 Saturation
O2 Sat (% Sat)
RM 122
RM 53
CAMAS Date [PST] vs YSI DO %
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13

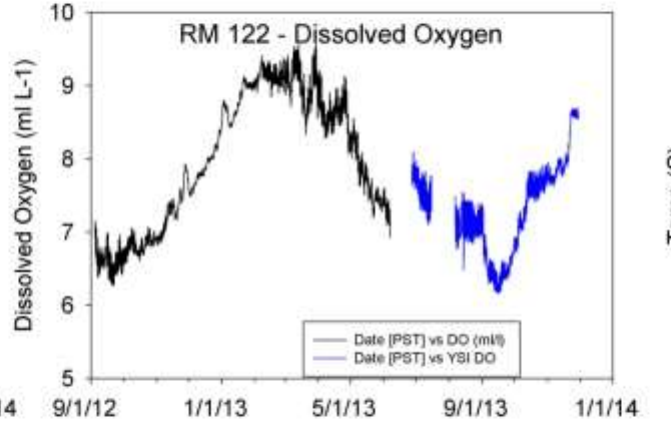

Nitrate
Nitrate (µM)
RM 122
RM 53
09/01
12/01
03/01
06/01
09/01
12/01

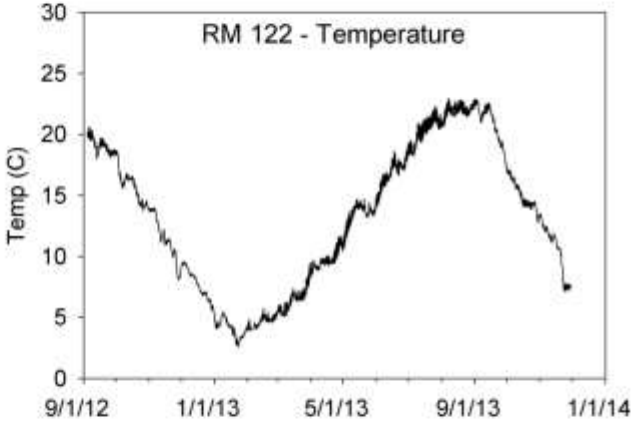

Discharge
RM 122
Discharge (m3 s-1x1000)
16
14
12
10
8
6
4
2
0
9/1/12
12/1/12
3/1/13
6/1/13
9/1/13
12/1/13

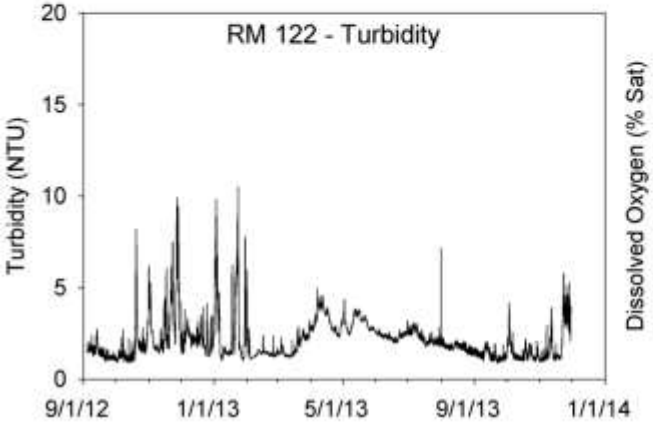

RM 122 - Chlorophyll a
Chl a (µg L-1)
50
40
30
20
10
0
9/1/12
1/1/13
5/1/13
9/1/13
1/1/14

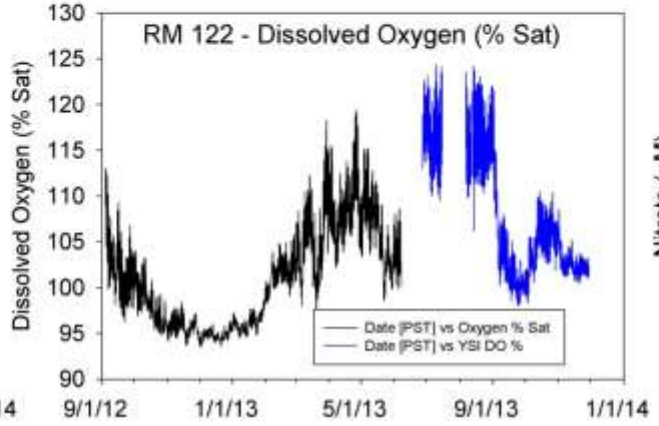

RM 122 - conductivity
S/m)
0.020
0.015
0.010
0.005
0.000
9/1/12
1/1/13
5/1/13
9/1/13
1/1/14

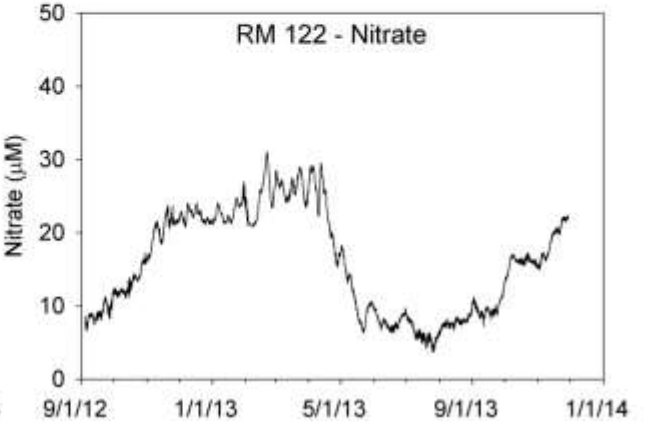

RM 122 - CDOM
CDOM (QSDE)
25
20
15
10
5
9/1/12
1/1/13
5/1/13
9/1/13
1/1/14


RM 122 - Dissolved Oxygen
Dissolved Oxygen (ml L-1)
10
9
8
7
6
5
Date [PST] vs DO (ml/l)
Date [PST] vs YSI DO
9/1/12
1/1/13
5/1/13
9/1/13
1/1/14


RM 122 - Temperature
Temp (C)
30
25
20
15
10
5
0
9/1/12
1/1/13
5/1/13
9/1/13
1/1/14


RM 122 - Turbidity
Turbidity (NTU)
20
15
10
5
0
9/1/12
1/1/13
5/1/13
9/1/13
1/1/14


RM 122 - Dissolved Oxygen (% Sat)
Dissolved Oxygen (% Sat)
130
125
120
115
110
105
100
95
90
Date [PST] vs Oxygen % Sat
Date [PST] vs YSI DO %
9/1/12
1/1/13
5/1/13
9/1/13
1/1/14


RM 122 - Nitrate
Nitrate (µM)
50
40
30
20
10
0
9/1/12
1/1/13
5/1/13
9/1/13
1/1/14

Quality control and Maintenance Trips

RM-53	RM-122
9/5/2012	9/5/2012
12/4/2012	12/10/2012
1/8/2013	1/16/2013
2/12/2013	2/7/2013
3/26/2013	3/27/2013
4/23/2013	4/17/2013
5/21/2013	5/29/2013
6/18/2013	6/27/2013
8/20/2013	7/15/2013
12/4/2013	8/6/2013
	8/14/2013
	9/3/2013
	12/15/2013