www.ecasa.org.uk

Water quality indicators across sites: preliminary results

Roberto Pastres: pastres@unive.it
Daniele Brigolin: brigo@unive.it

Dept. of Physical Chemistry

University of Venice, Italy.

Water quality data collected at seven ECASA sites were screened, in order to identify a common subset of indicators.

Four indicators were selected:

Ammonium	(μmol/l)
Soluble Reactive Phosphorus	(μmol/l)
Nitrate	(μmol/l)
Chlorophyll a	(μg/l)

These indicators were measured at:

Finfish

Cephalonia (Greece):	Seabream/ Seabass
Sounio (Greece):	Seabream/ Seabass
Bisceglie (Italy):	Seabream/ Seabass
Pirano (Slovenia):	Seabream and Seabass
Dalmar (Croatia):	Seabream/ Seabass
Garrucha:	Tuna ranching

Shellfish

Chioggia (Italy):	off-shore long-line mussel farm

The indicators were measured at a reference station and at one or more impacted ones.

These stations were selected on the basis of site-specific hydrograhic data.

Water samples were taken at different depths.

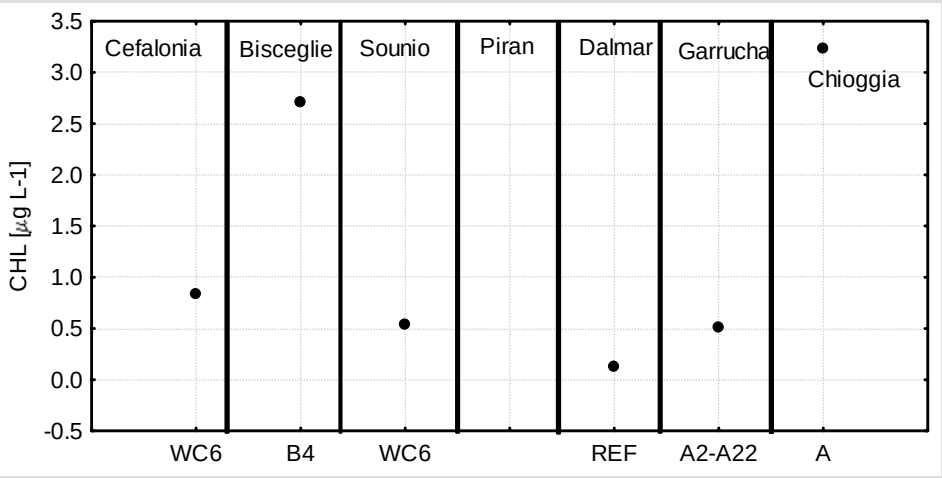
The data were pooled as follows:

$0 < z < 3$	surface
$3 < z < 15$	middle
$z > 15$	bottom

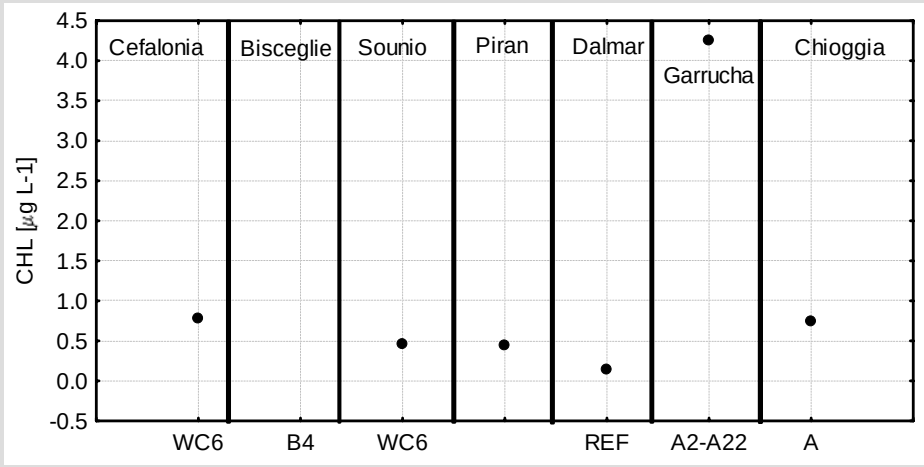
z = depth (m)

Chlorophyll a (μg/l)

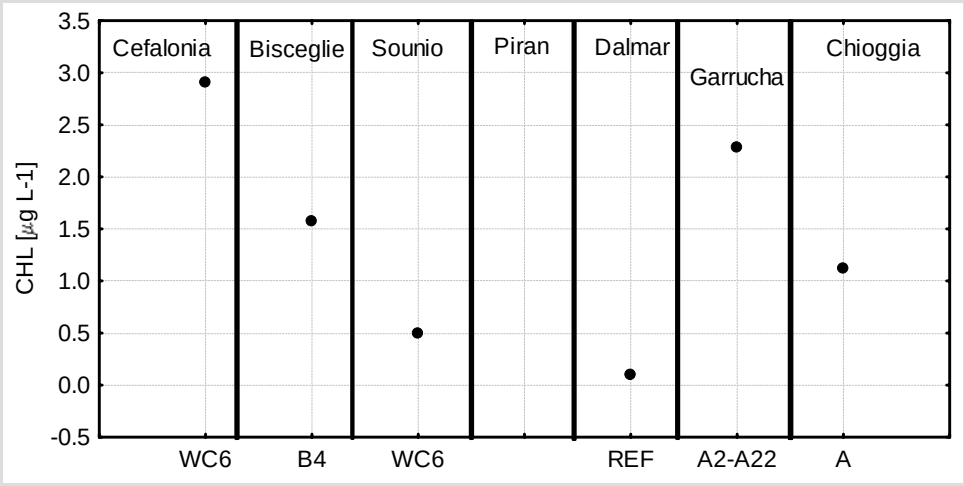
Surface



Middle

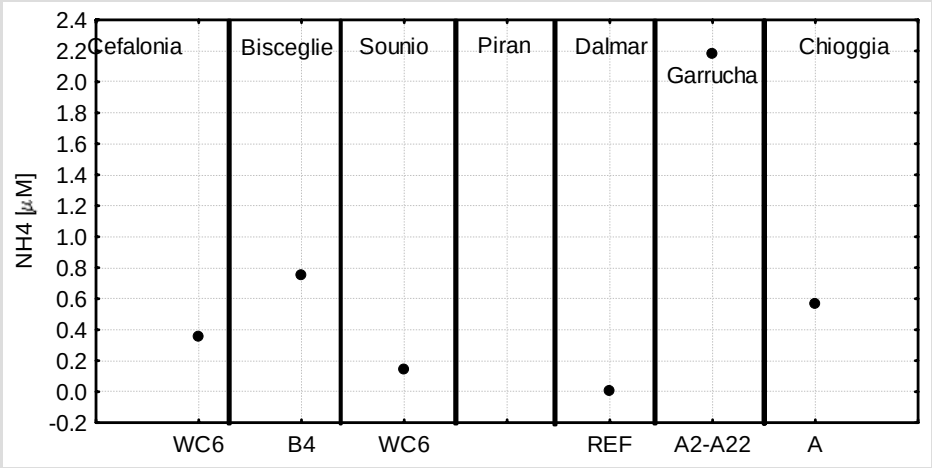


Bottom

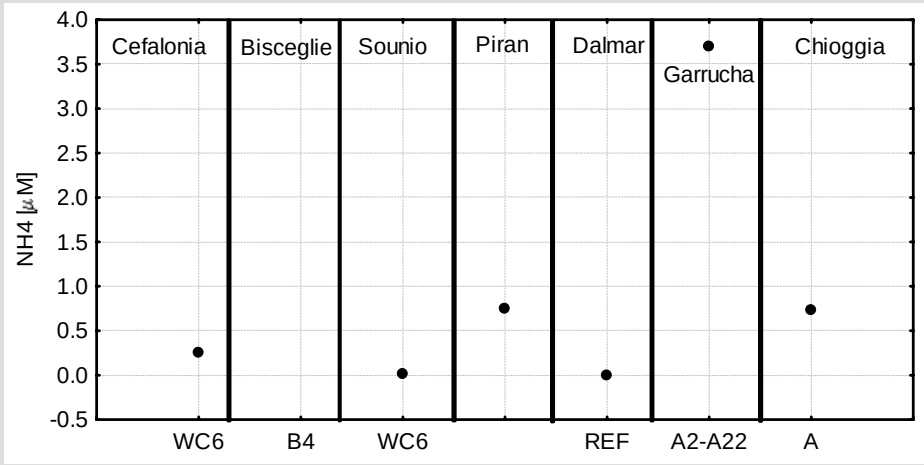


Ammonium (μM/l)

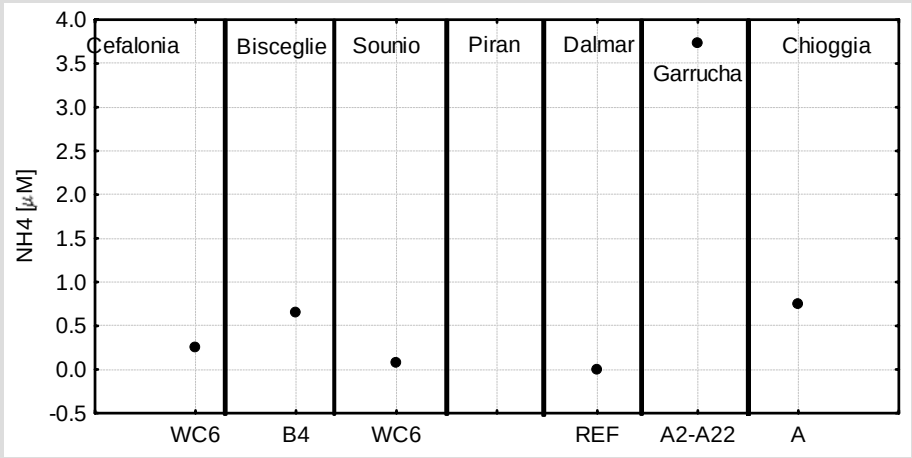
Surface



Middle

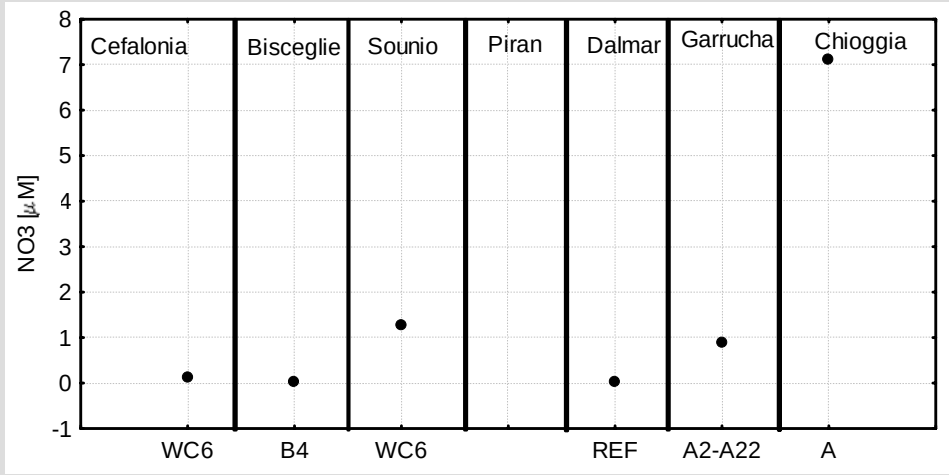


Bottom

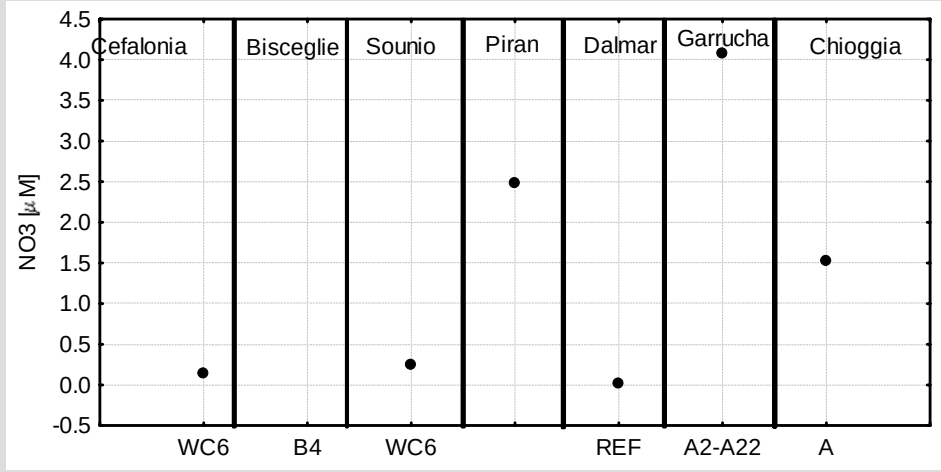


Nitrate (μM/l)

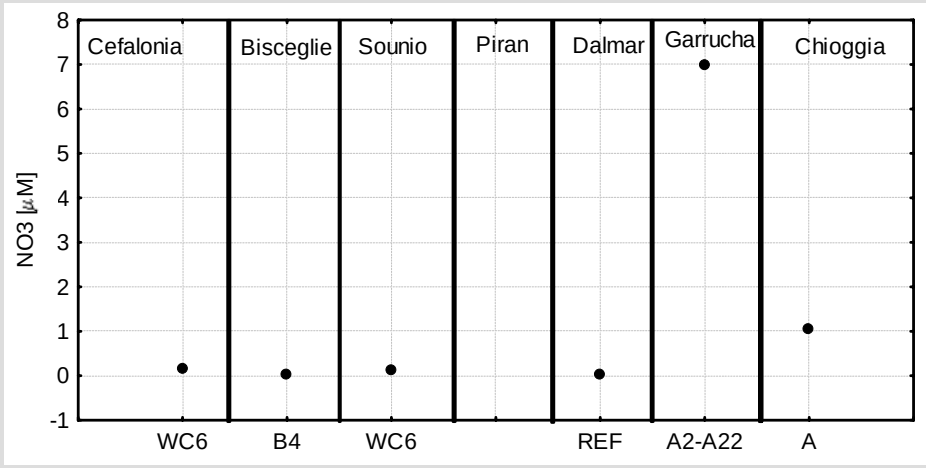
Surface



Middle

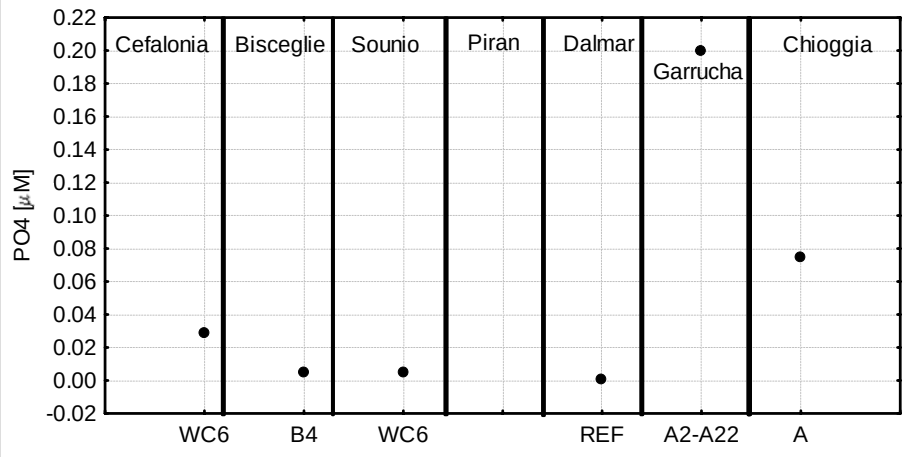


Bottom

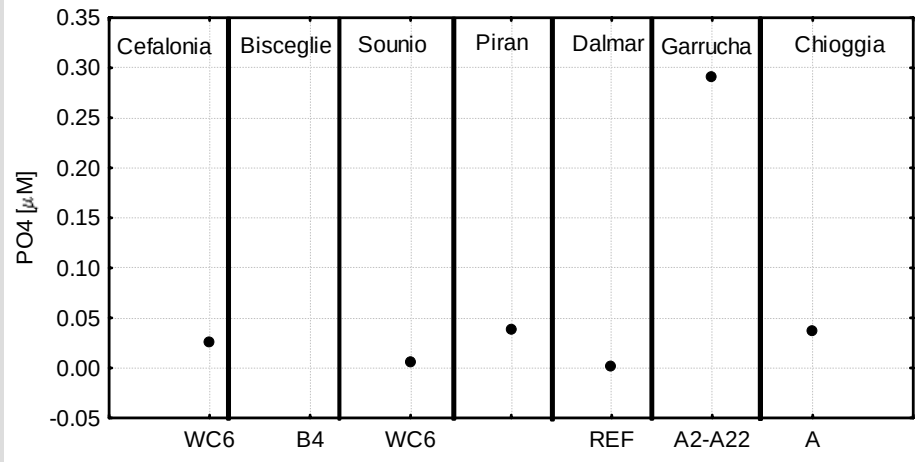


SRP (μM/l)

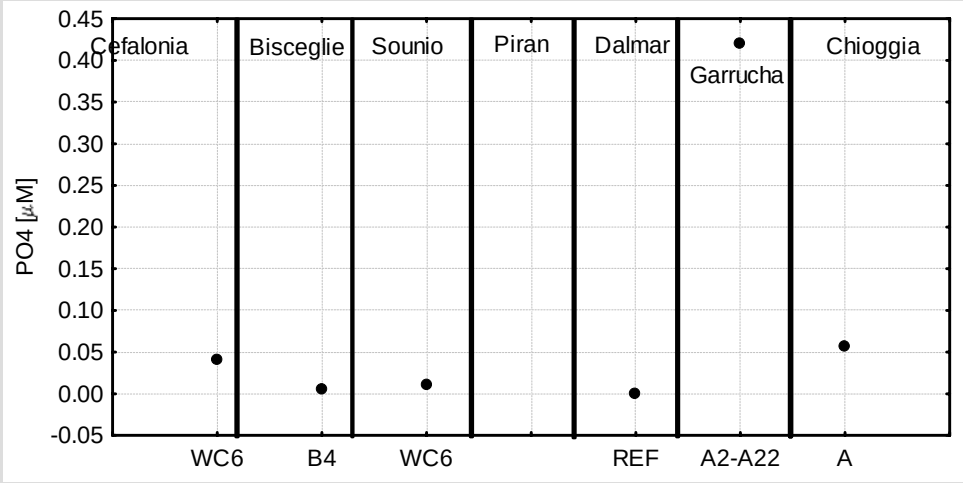
Surface



Middle



Bottom



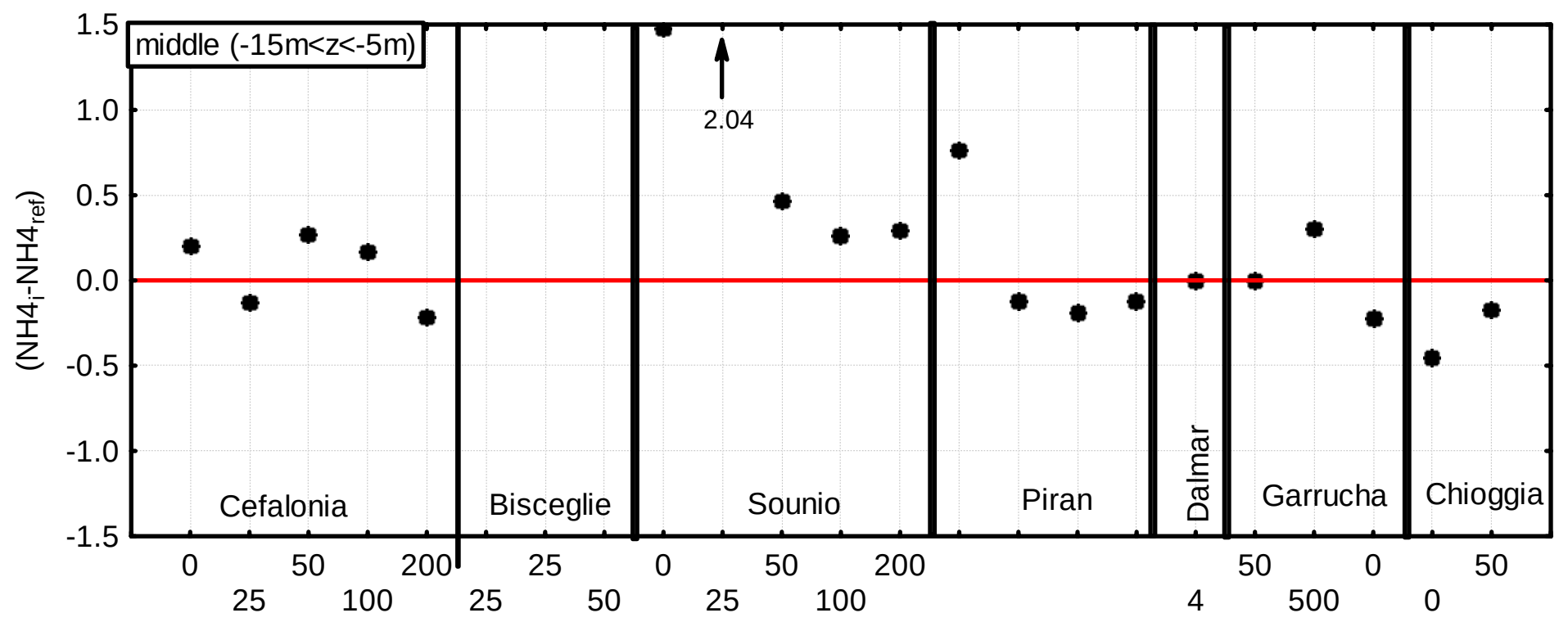
Impact assessment

For each depth, one can plot the differences: $x_i = C_i - C_r$

C_i = concentration at a given sampling station

C_r = concentration at the reference site

Ammonium: middle



The data were treated in order to:

- summarize the variability of indicators;
- investigate the statistical relationships among indicators:
- relate the variability across sites to the pressure and to the site-specific assimilative capacity;

In order to achieve these goals, we computed a dimensionless impact index:

$$x_i = \log(C_i/C_r)$$

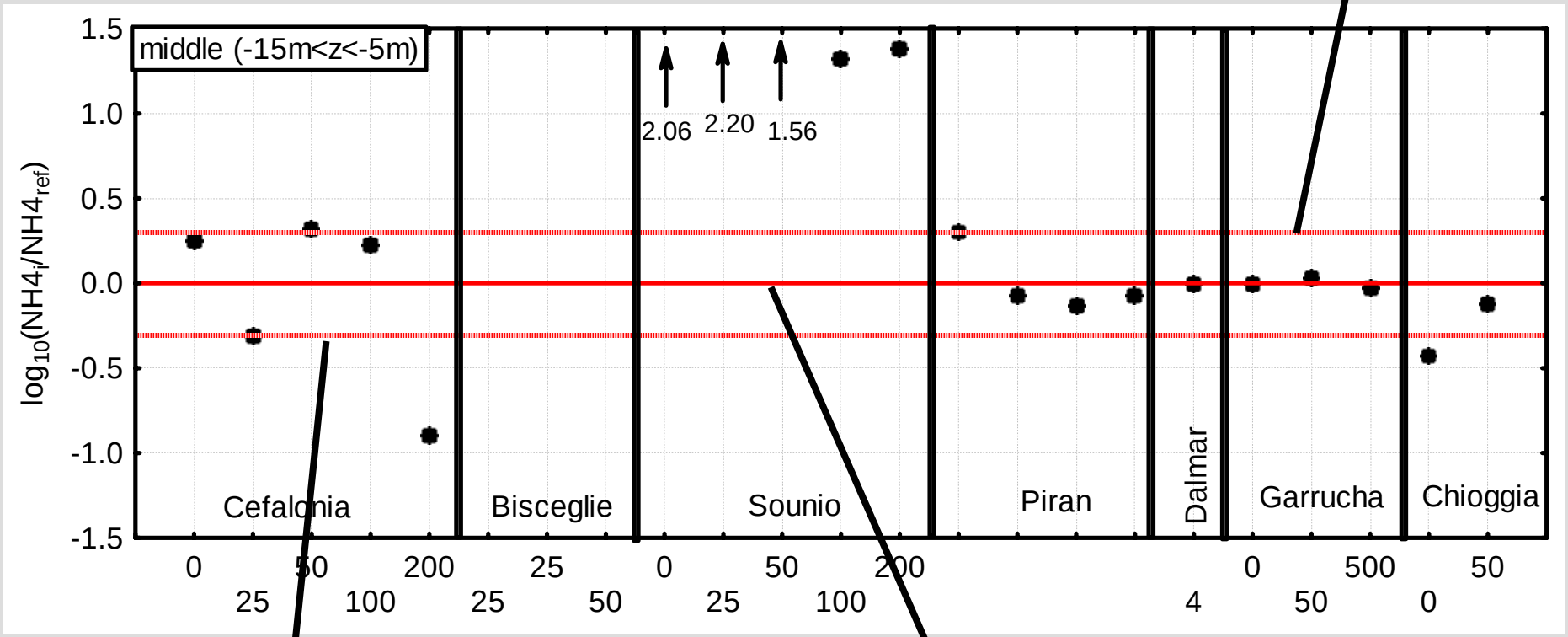
C_i = concentration at a given sampling station

C_r = concentration at the reference site

$C_i = C_r$ ⟹ $x_i = 0$

Ammonium : middle water column

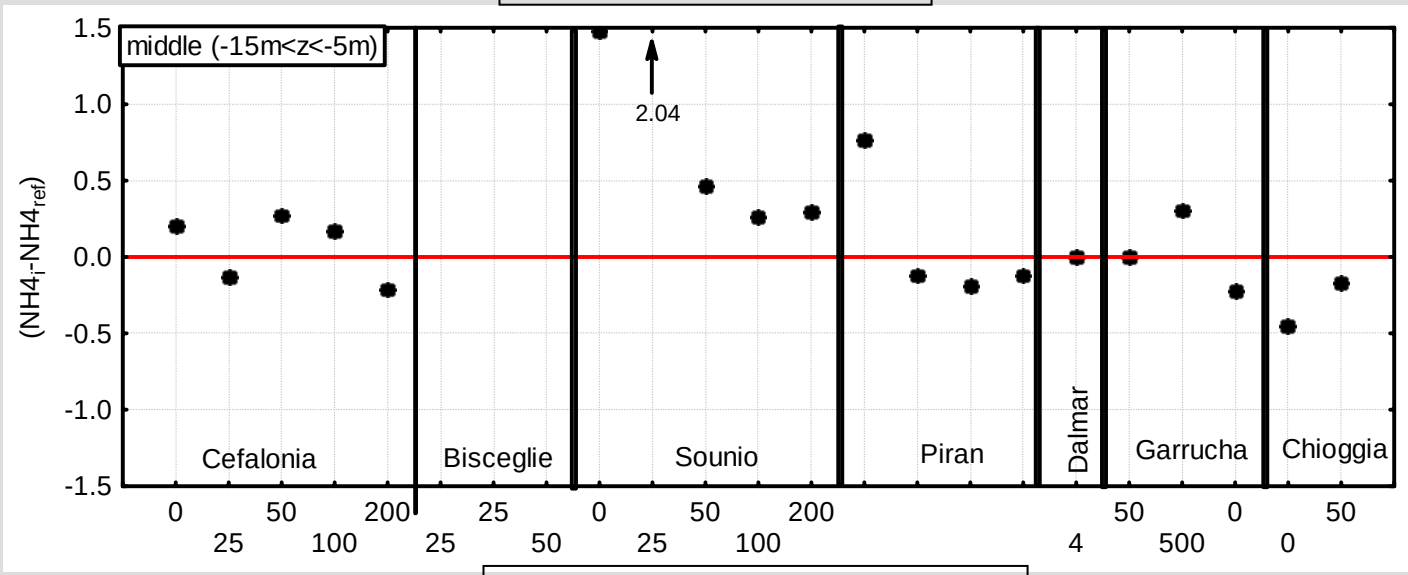
$C_i = 2 \times C_r$



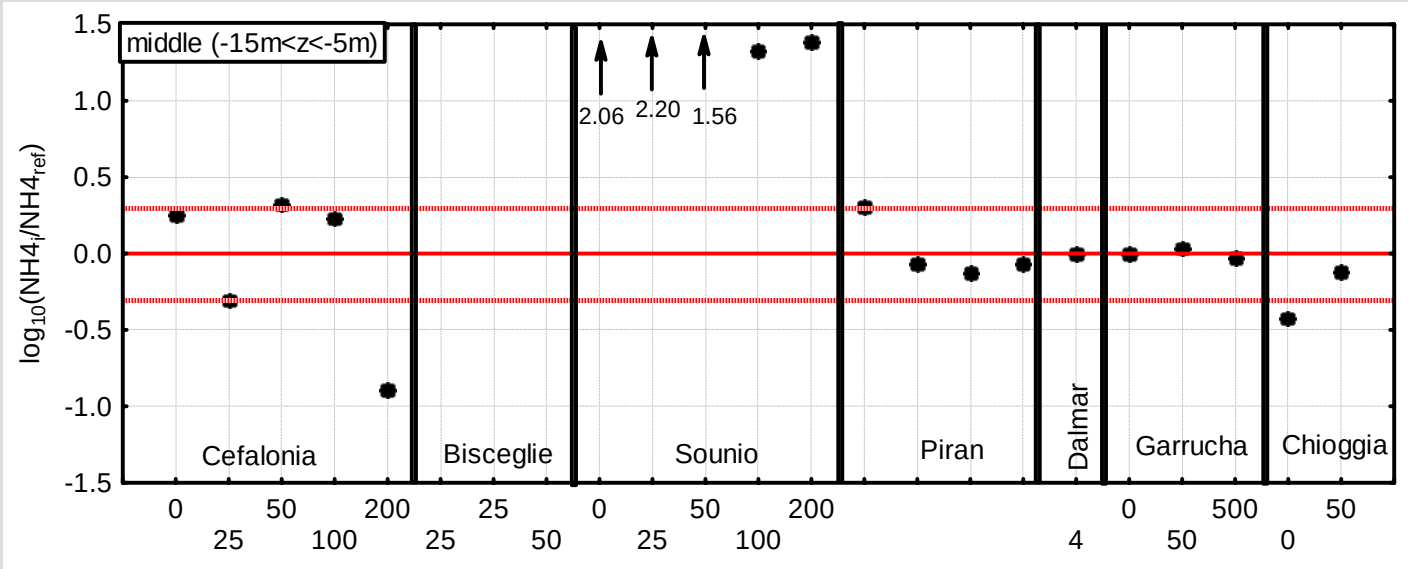
$C_i = C_r/2$

$C_i = C_r$

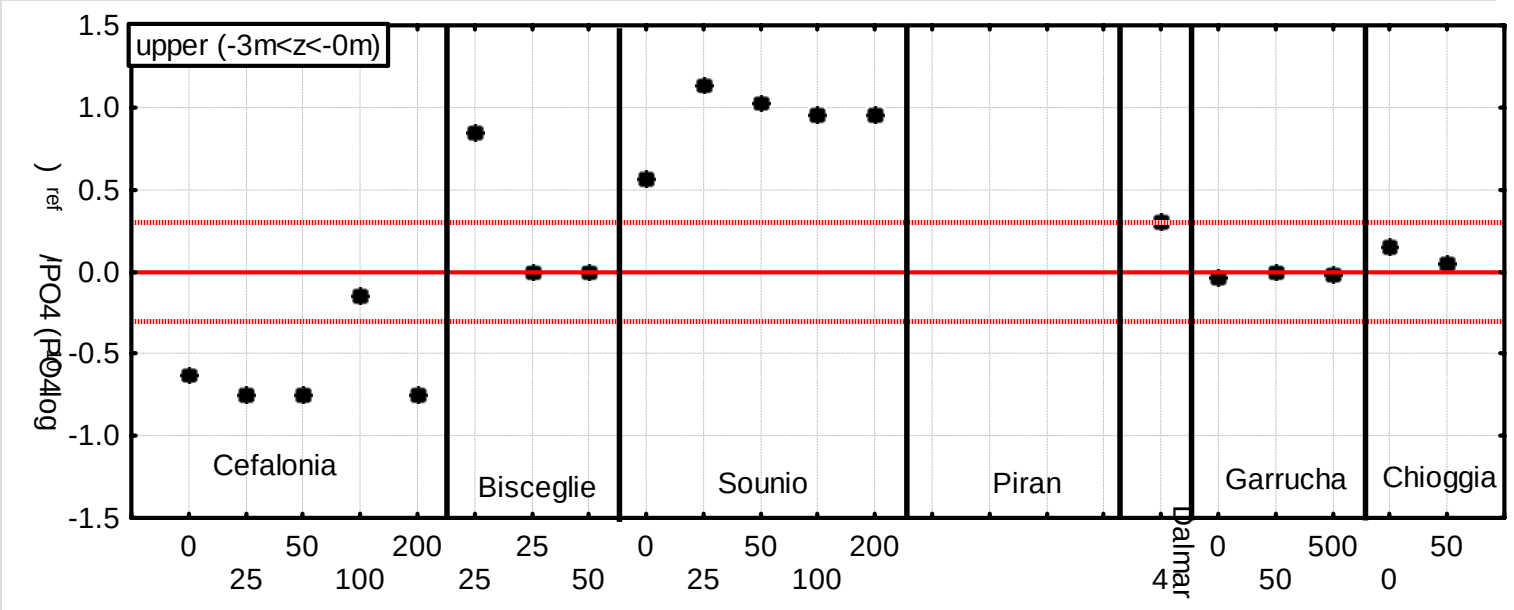
$$x_i = C_i - C_r$$



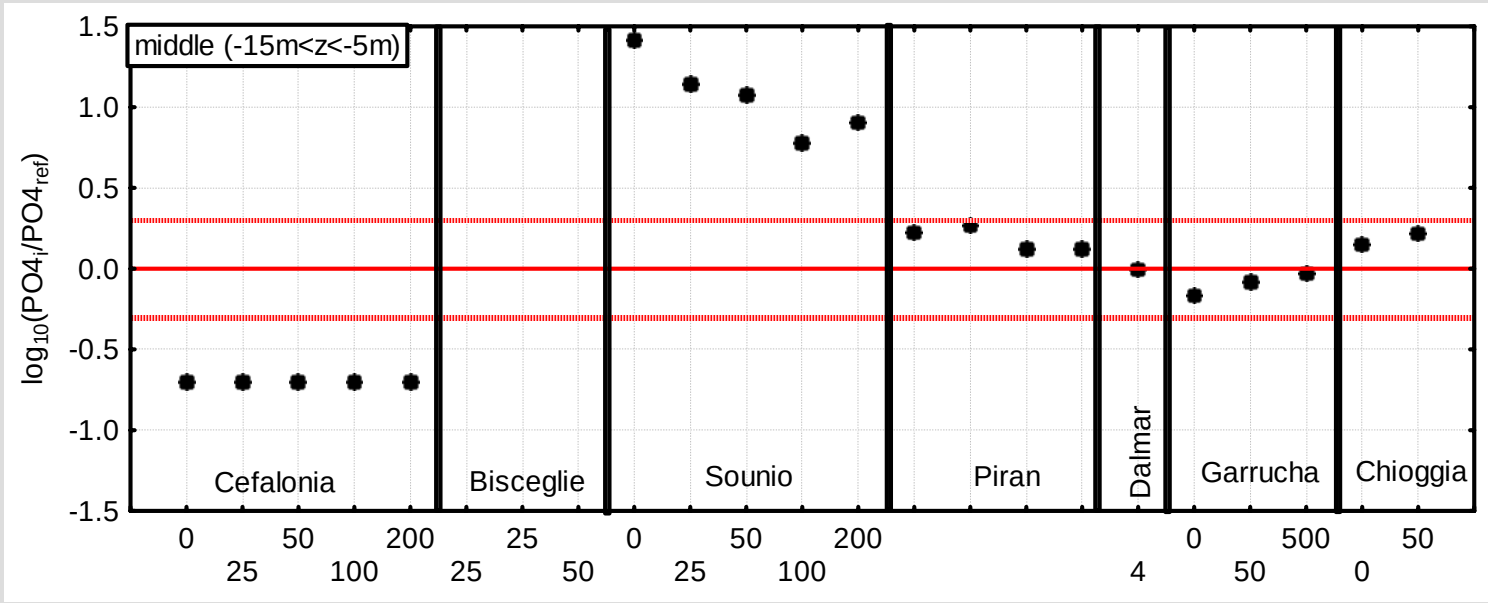
$$x_i = \log(C_i/C_r)$$



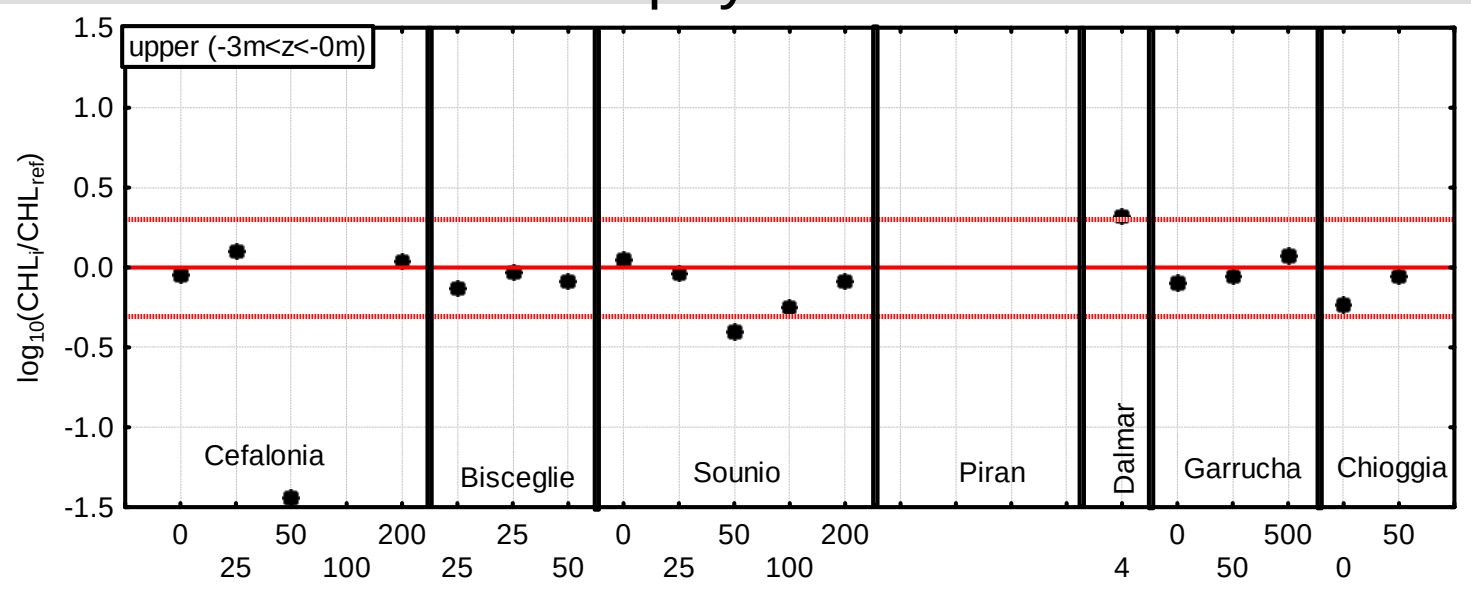
SRP: surface



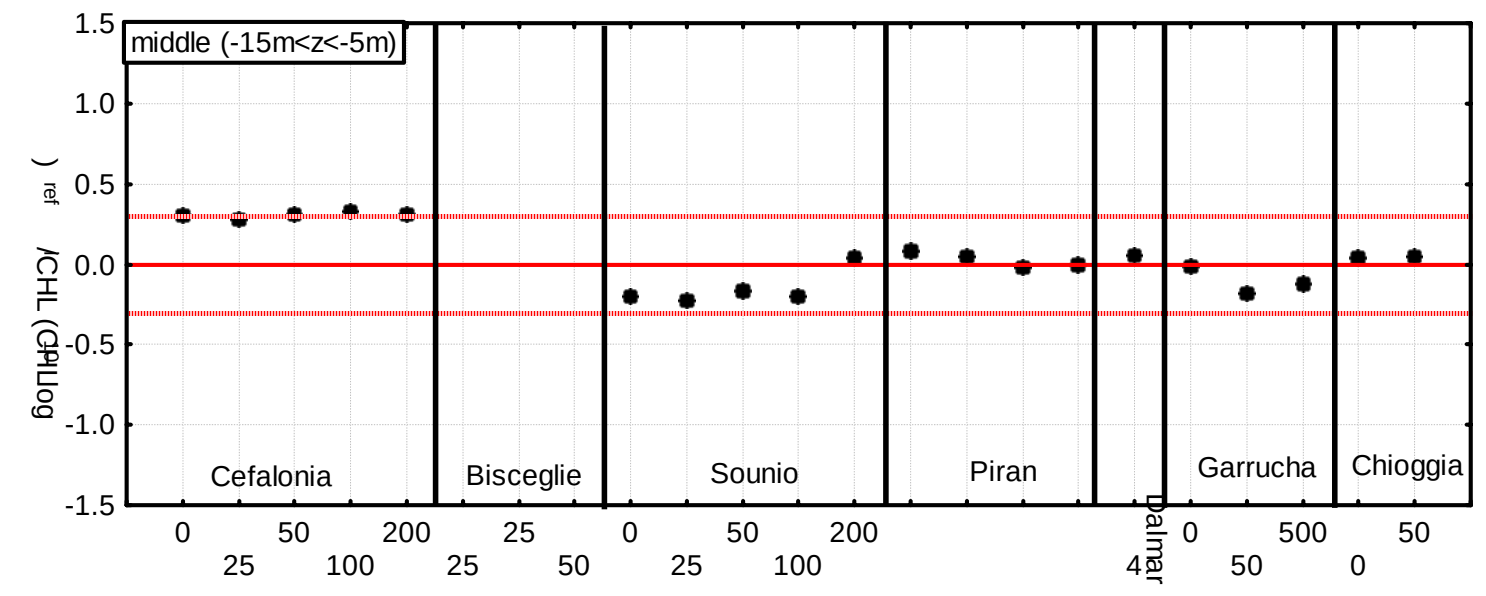
SRP: middle



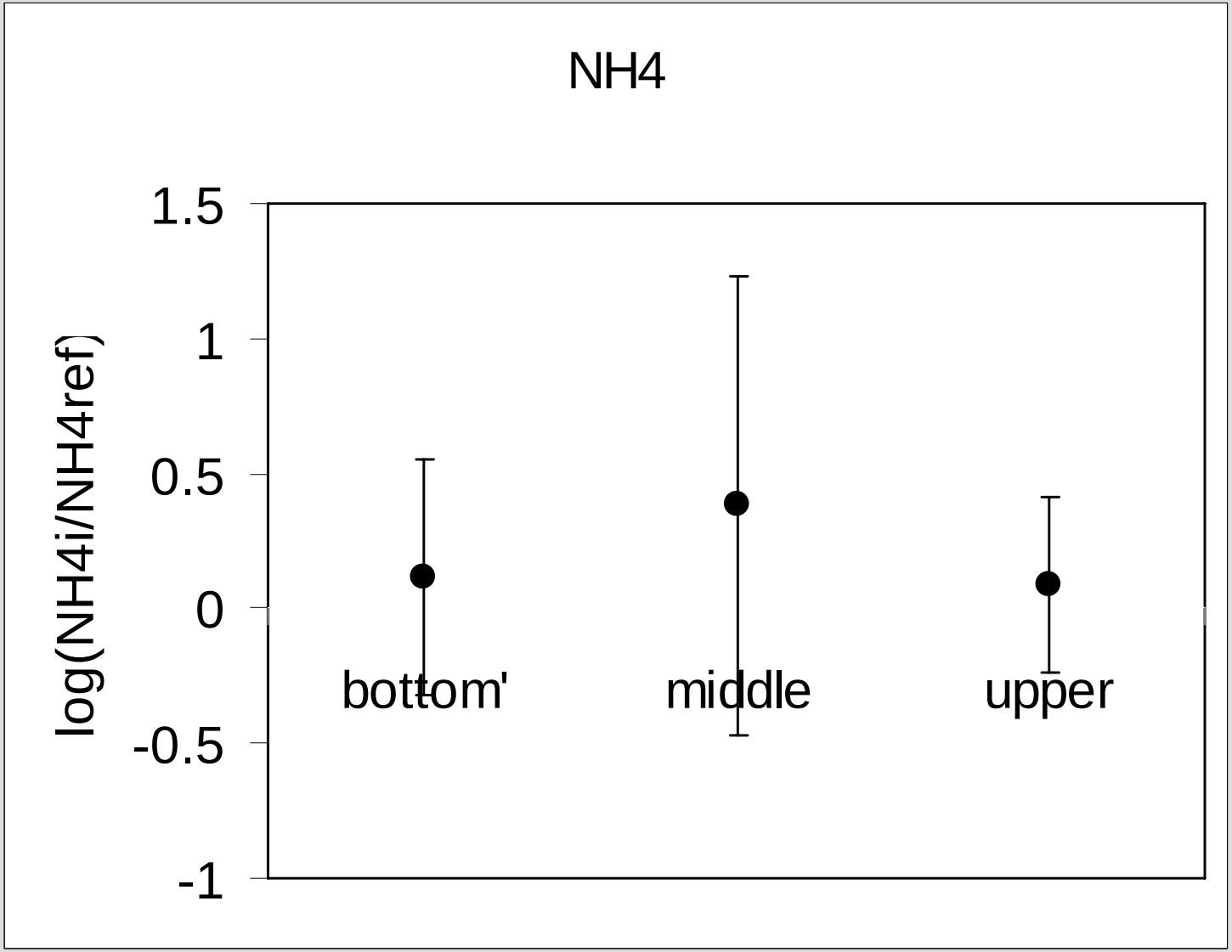
Chlorophyll a: surface

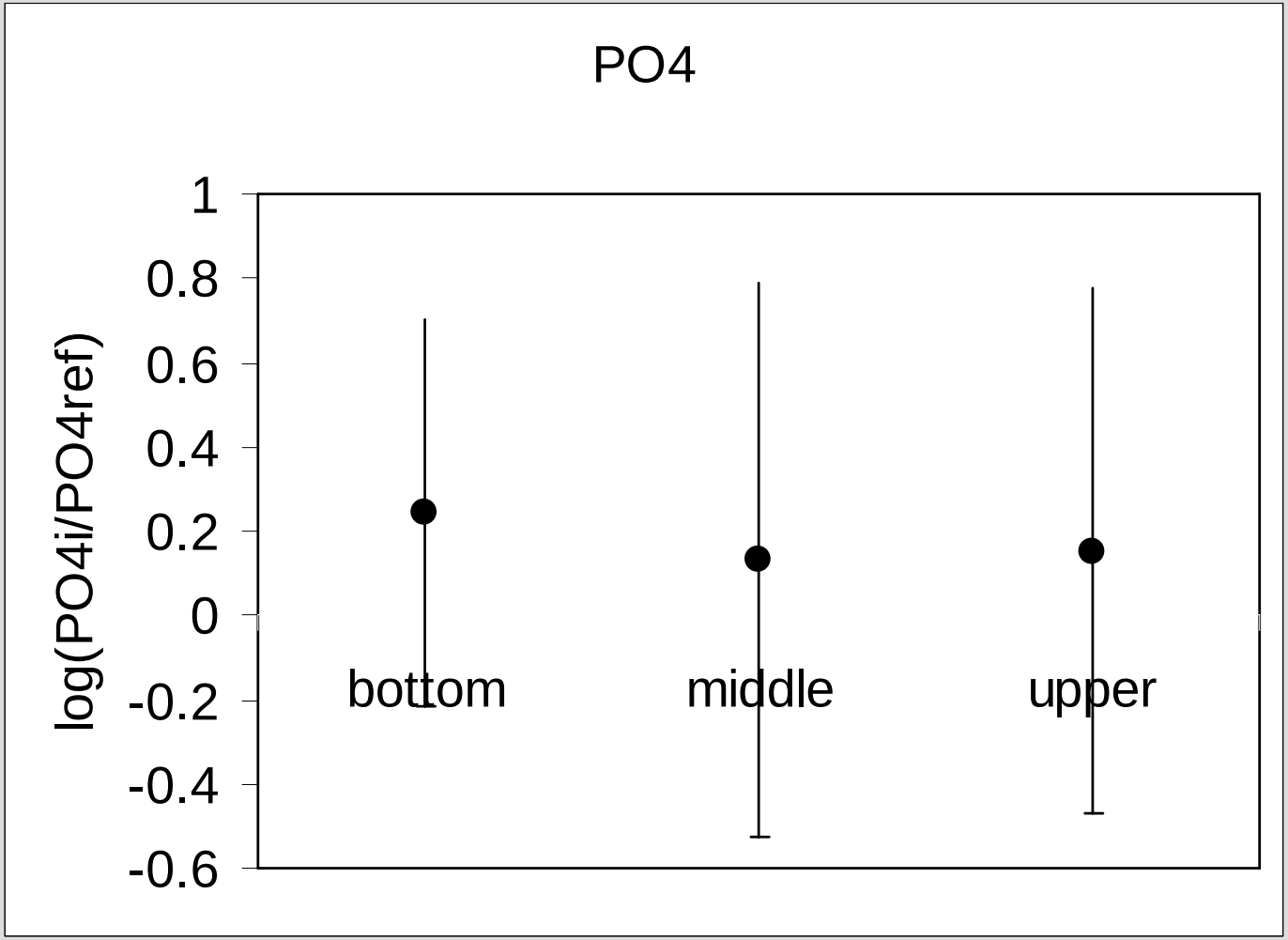


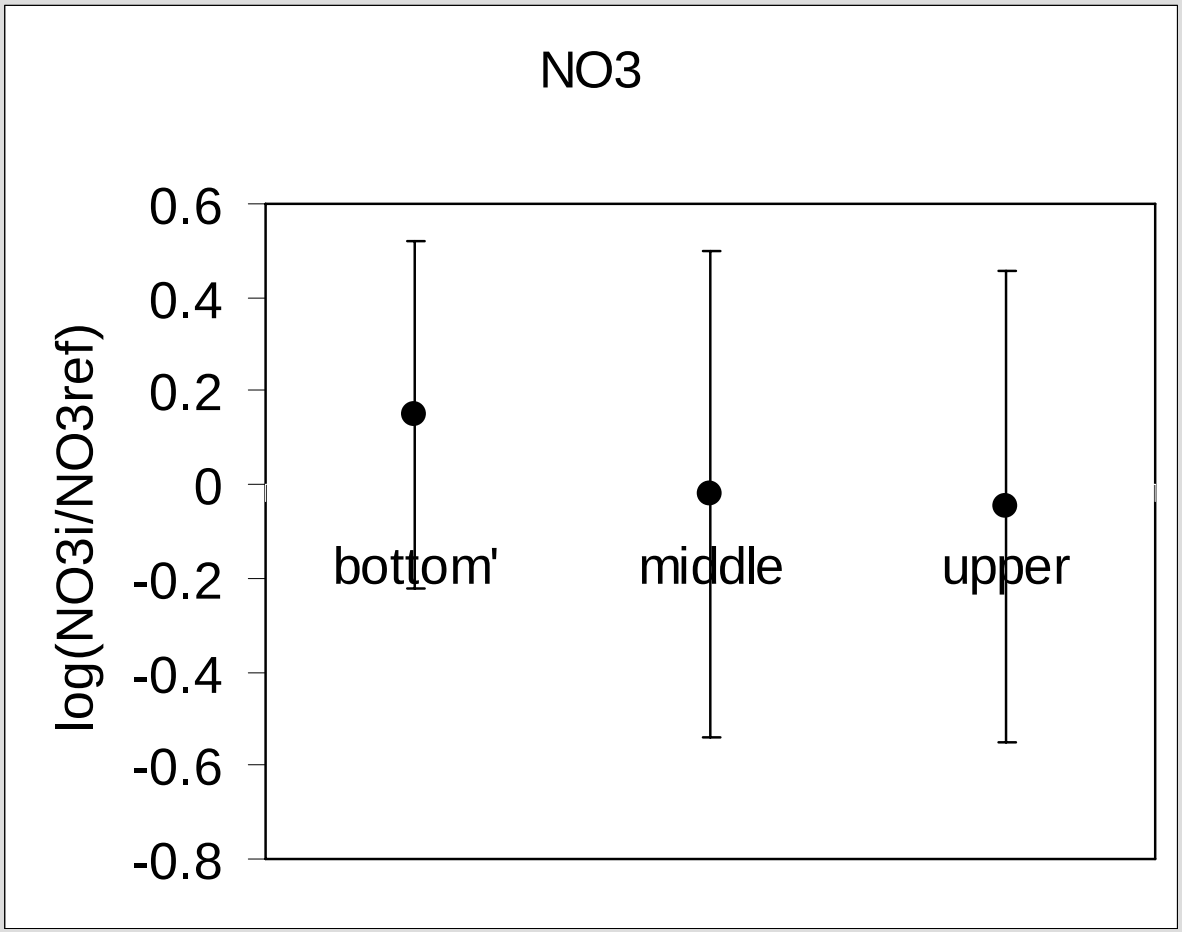
Chlorophyll a: middle

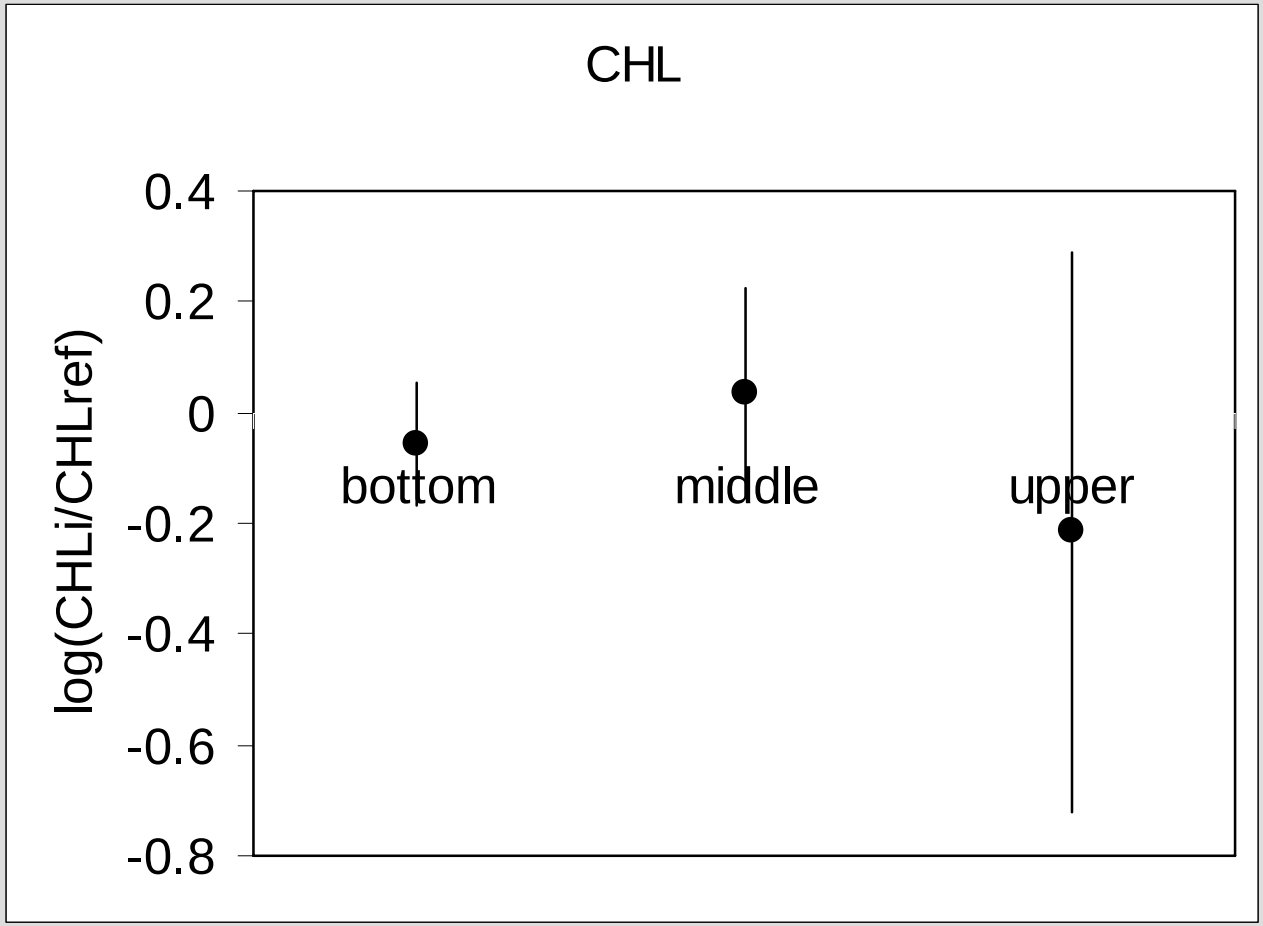


In general, the variability of water quality indicators is higher in the middle layer



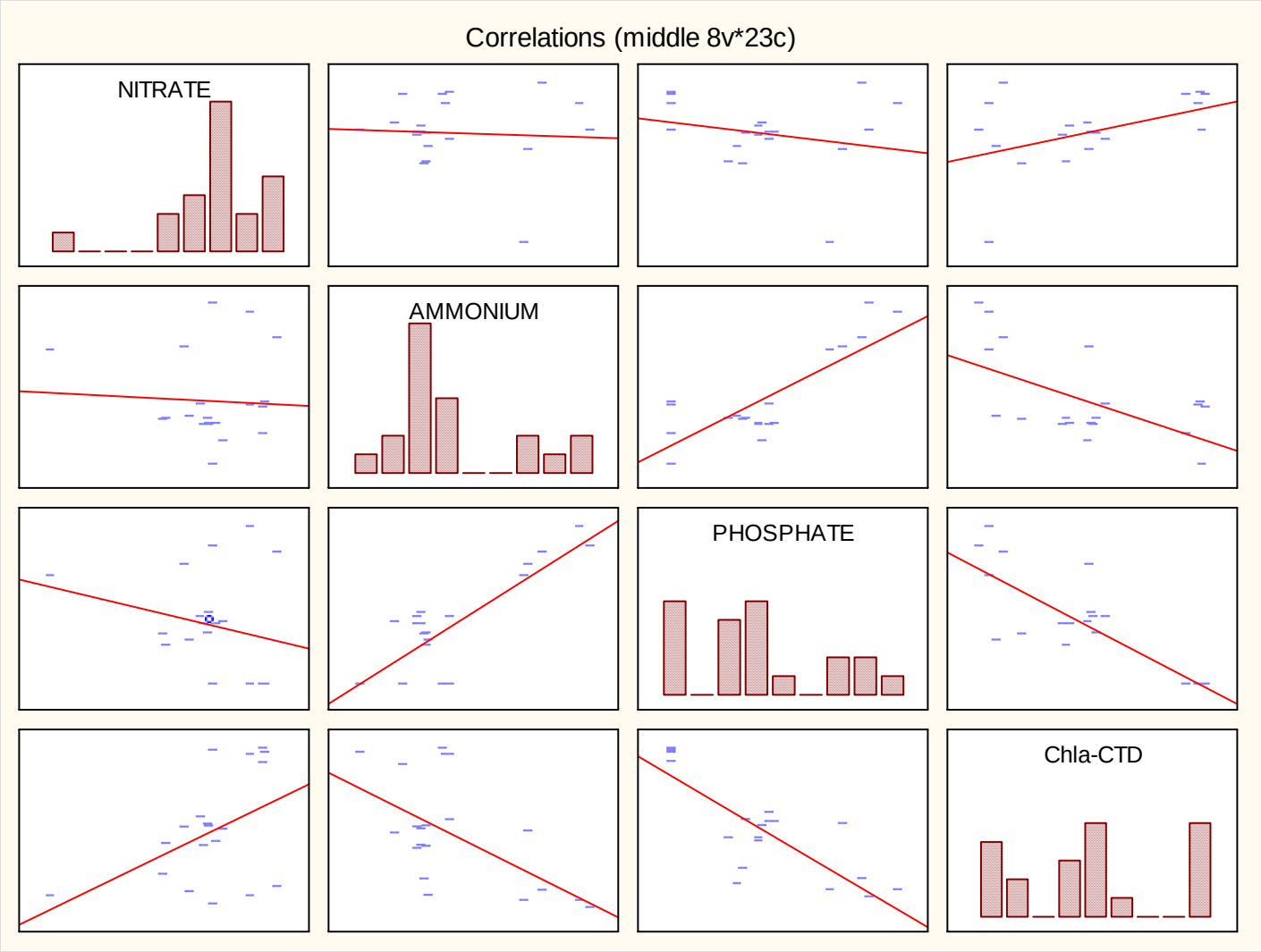

PO4
log(PO4i/PO4ref)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
bottom
middle
upper


NO3
log(NO3i/NO3ref)
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
bottom'
middle
upper


CHL
log(CHLi/CHLref)
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
bottom
middle
upper

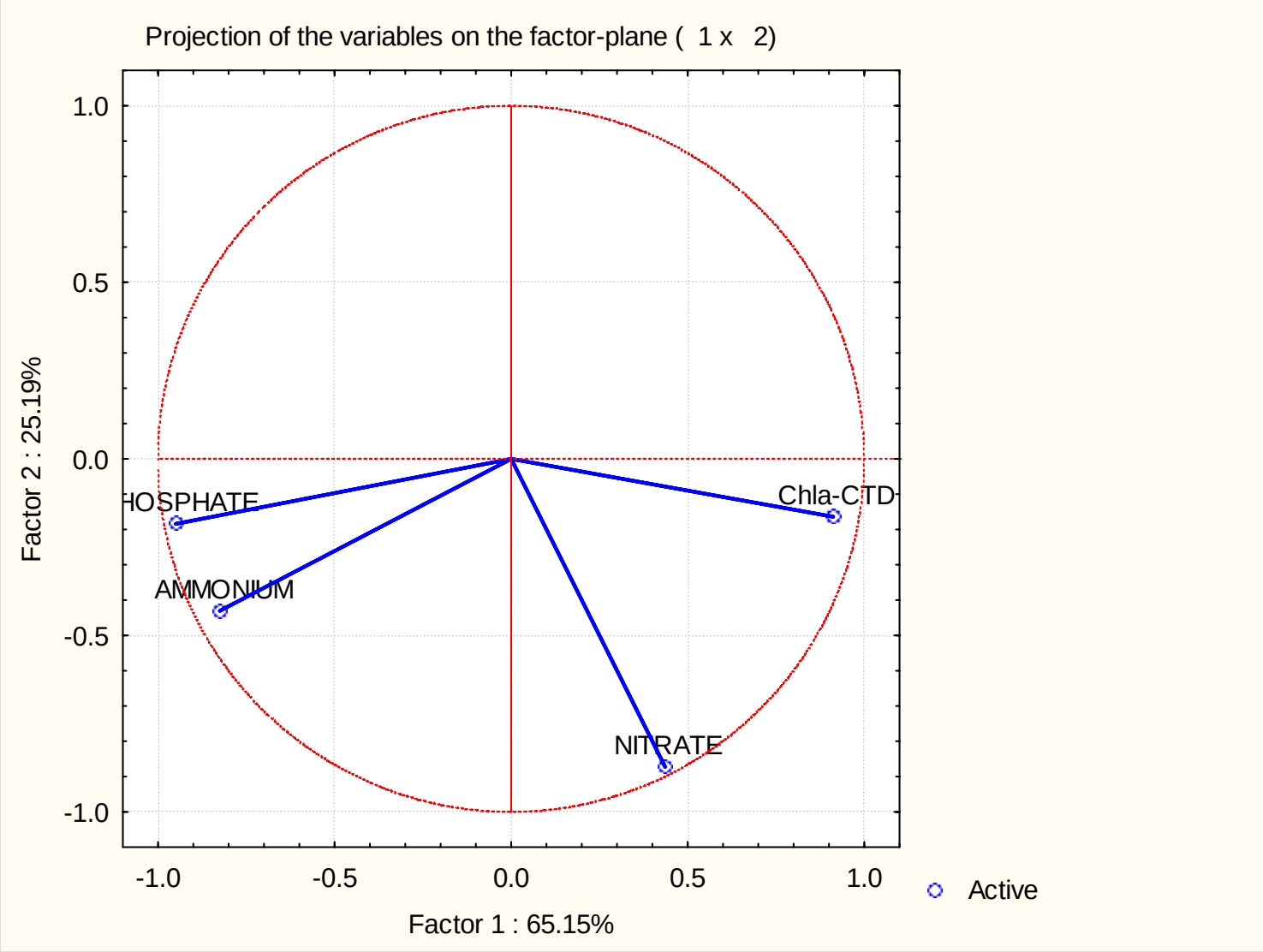
The analysis of this data set indicates that water quality indicators are correlated.

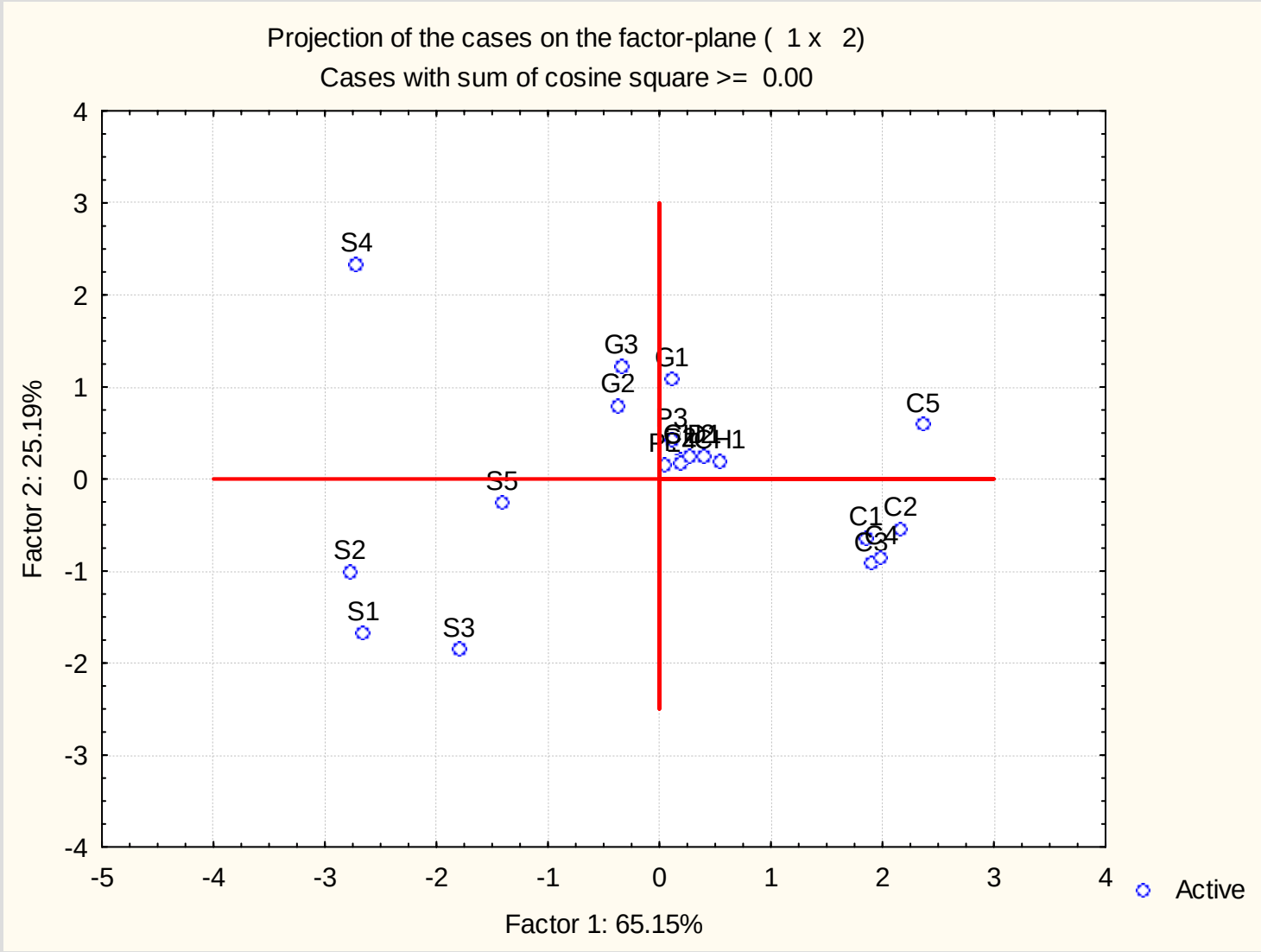
Middle layer



Principal Component Analysis

Middle water column




Projection of the cases on the factor-plane (1 x 2)
Cases with sum of cosine square >= 0.00
Factor 2: 25.19%
Factor 1: 65.15%
S4
G3
G1
G2
C5
H1
S5
C1
C2
S2
S1
S3
Active

Water quality indicators:

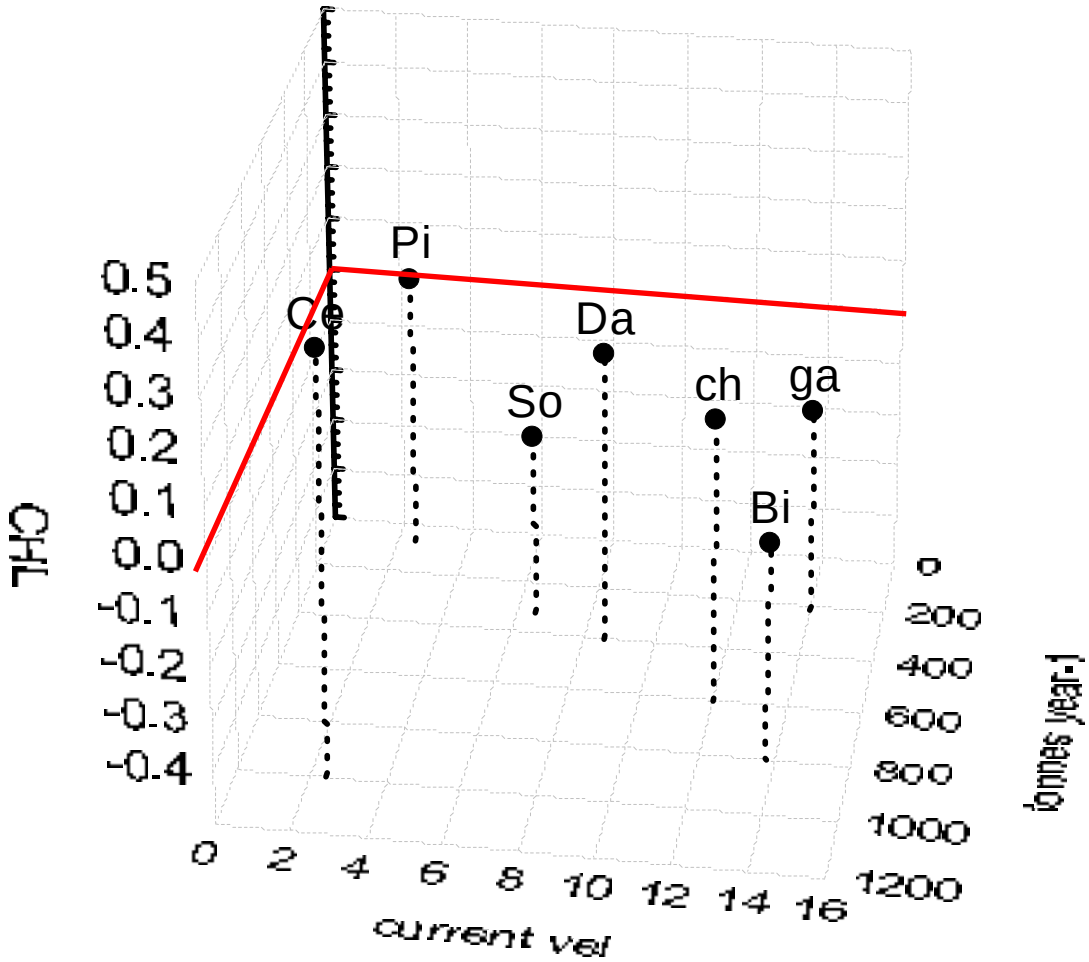
Pressure-Impact relationships:

X: Assimilative Capacity: average current velocity

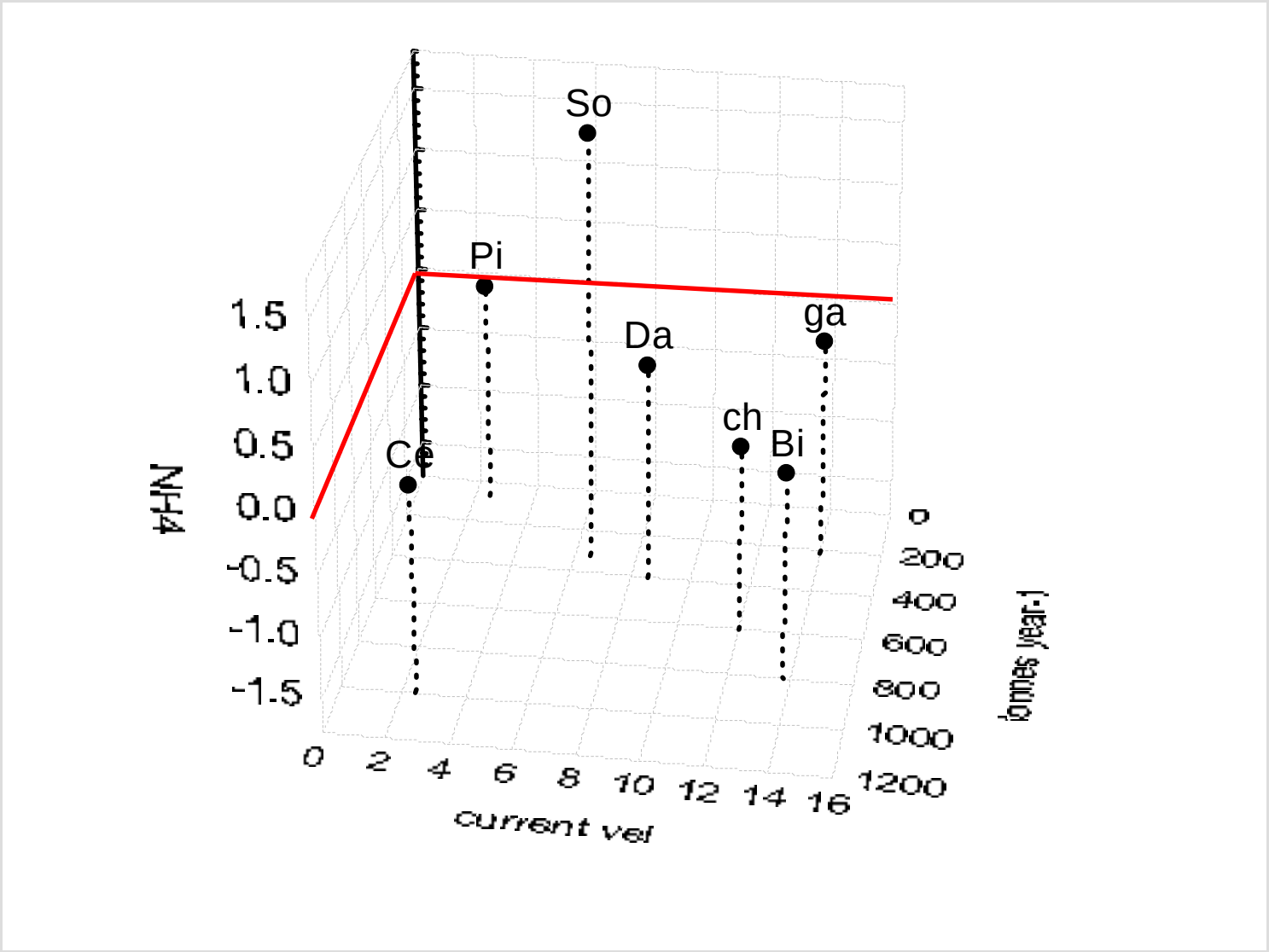
Y: Pressure: Biomass standing stock

Z: Impact: mean value of $\log(C_i/C_r)$ at each site and depth

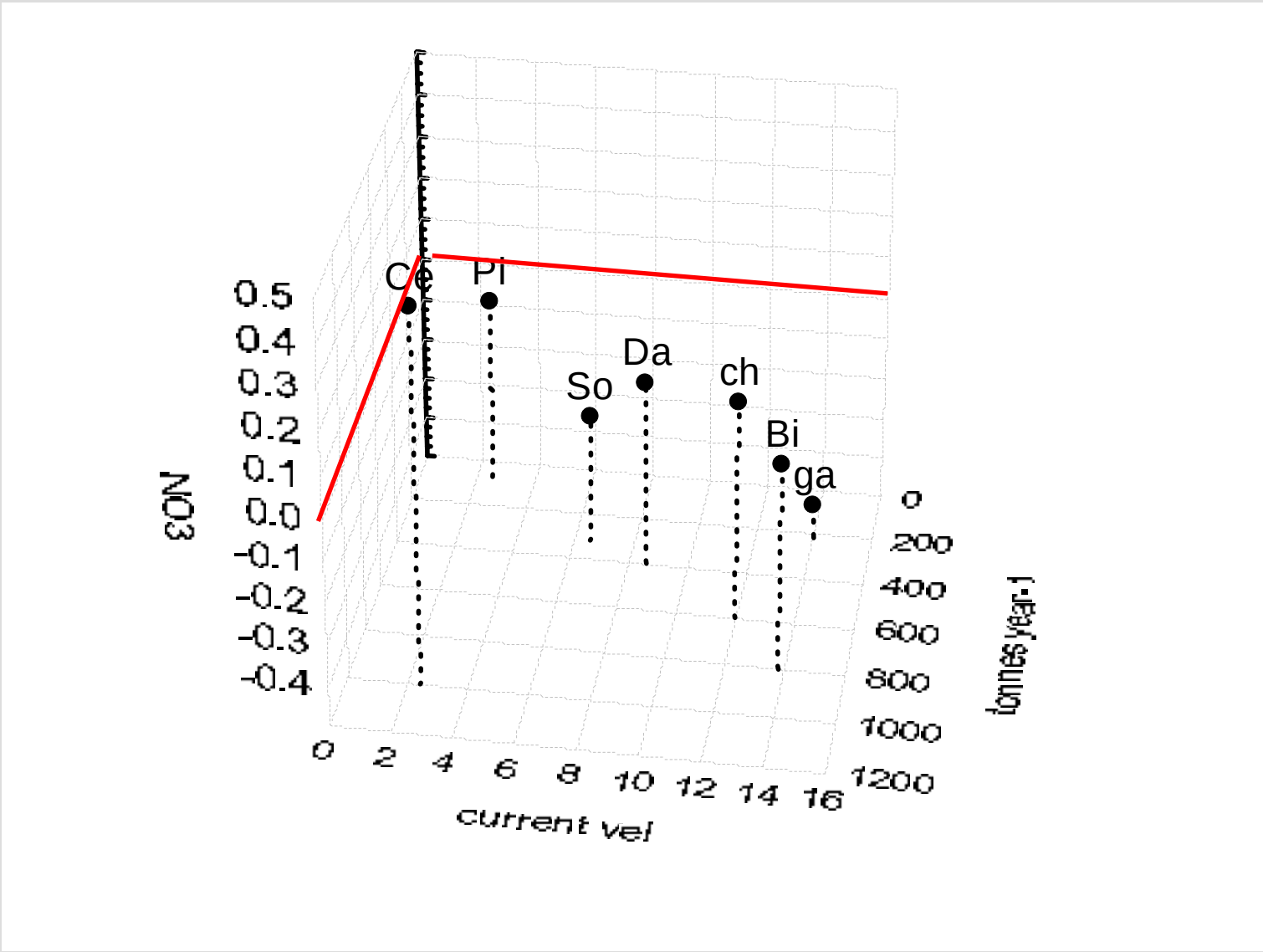
Chlorophyll a



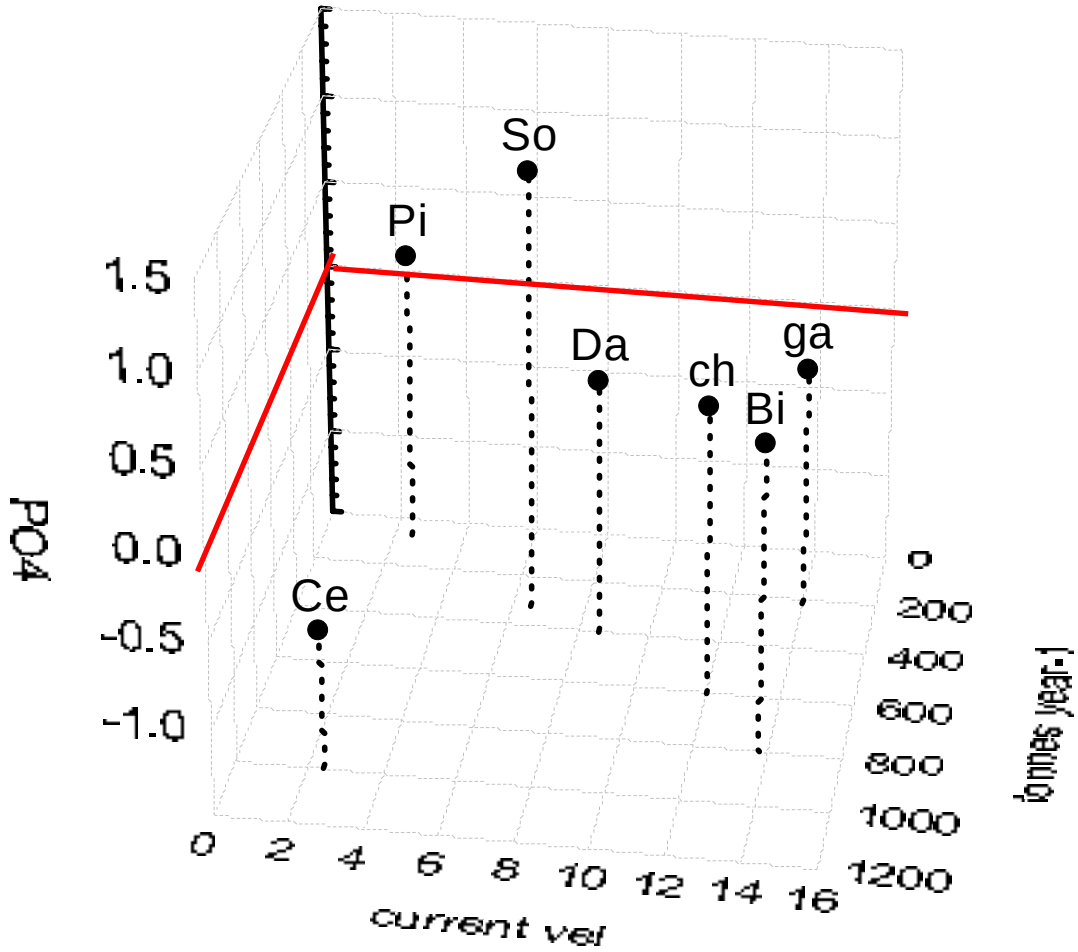
Ammonium


So
Pi
Da
ga
ch
Bi
Ce
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
NH4
0
2
4
6
8
10
12
14
16
current vel
0
200
400
600
800
1000
1200
tonnes year-1

Nitrate


NO3
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
Ce
Pl
So
Da
ch
Bi
ga
0
2
4
6
8
10
12
14
16
current vel
0
200
400
600
800
1000
1200
tonnes year-1

SRP


So
Pi
Da
ch
ga
Bi
Ce
1.5
1.0
0.5
0.0
-0.5
-1.0
PO4
0
2
4
6
8
10
12
14
16
current vel
0
200
400
600
800
1000
1200
tonnes year-1

Conclusions

At most sites, the selected WQ indicators do not show clear gradients.

Causes:

WQ variability is much higher;

Dispersion needs to be taken into account