Productivity and structure of lower trophic level communities and carbon flux in the Ulleung Basin in the JES in the summer of 2005

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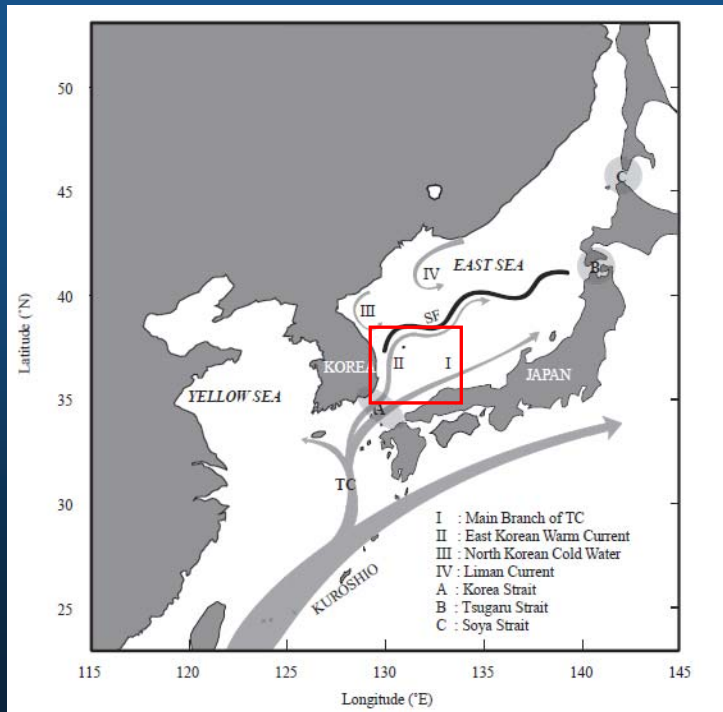
Outline

- Backgrounds
- Physical setting
- Coastal upwelling
- Biological structure
- Carbon fluxes
- Summary

Ulleung Basin

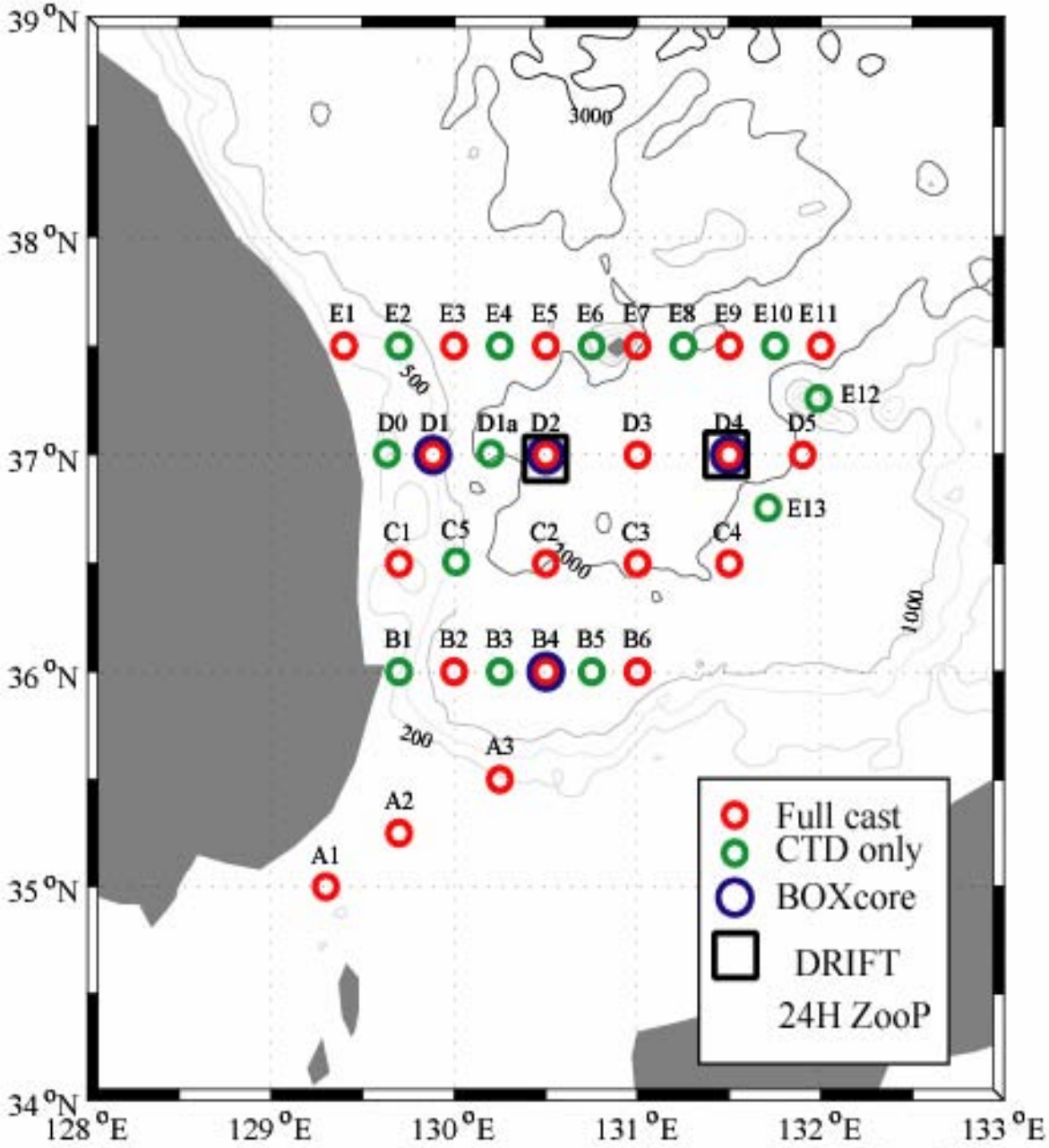
- Tsushima current
- North Korean Cold Current
- Eddies
  - Anti-cyclonic eddies are formed and stay in the Ulleung Basin for more than one or two years.
- Seasonal stratification
  - Phytoplankton density is lowest in summer showing bimodal annual cycles
- Coastal Upwelling
  - During summers, southwesterly wind induces coastal upwelling along the Korean penisula.



Question

- How the eddy and other hydrographic features shape the lower trophic level and influence the carbon fluxes in the basin in summer?

동해 탄소순환 정점도
2005. 07.19 ~ 08.01

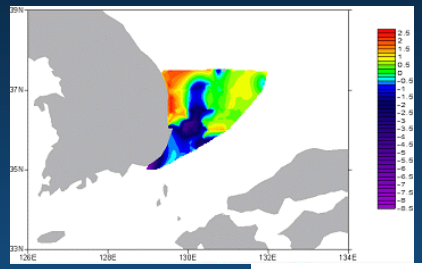


* Full cast: OCP, Net, CTD

In-situ measurements

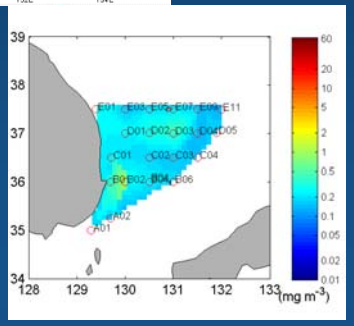
Atmosphere

① carbon dioxide



Upper ocean

② biological processes



③ organic carbon sinking

Deep ocean

④ Sinking and recycling

Sediments

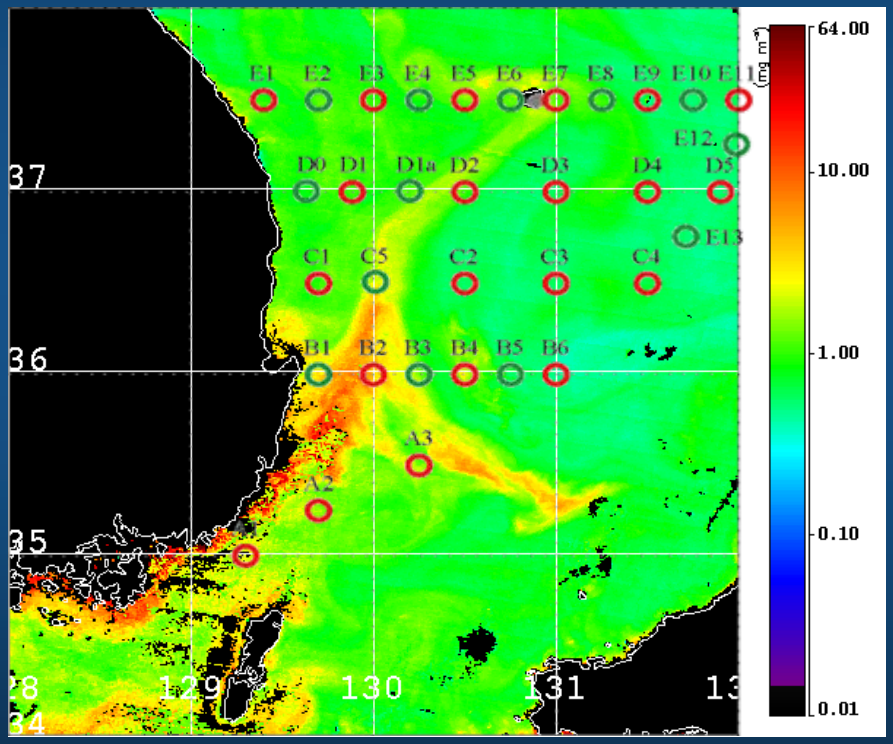
⑤ Organic carbon sedimentation

Methods and materials

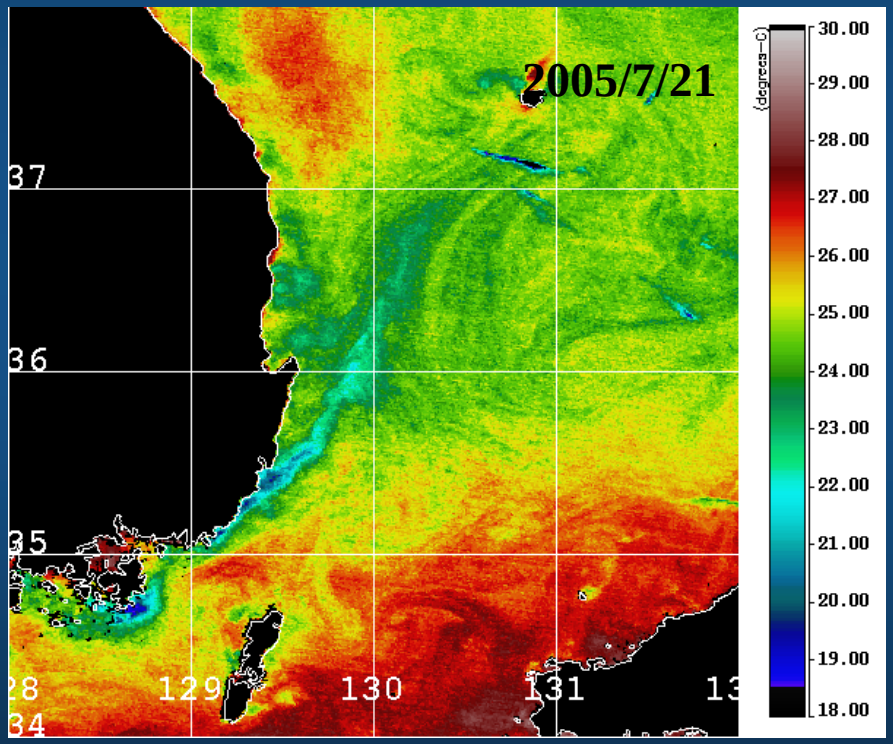
- Physics: CTD, ADCP
- Chemistry: Carbon dioxide, nutrients
- Biolo
  - Phytoplankton: PP, HPLC pigments, picoplankton
  - Bacteria: biomass, production
  - Microzooplankton: abundance, grazing
  - Mesozooplankton: abundance, fecal pellet analysis
- Sinking flux
  - Drifting sediment traps (at 2 locations for 24 hours each)
- Incubation chamber
  - Refer to the poster presentation by Lee & Kim (this meeting)

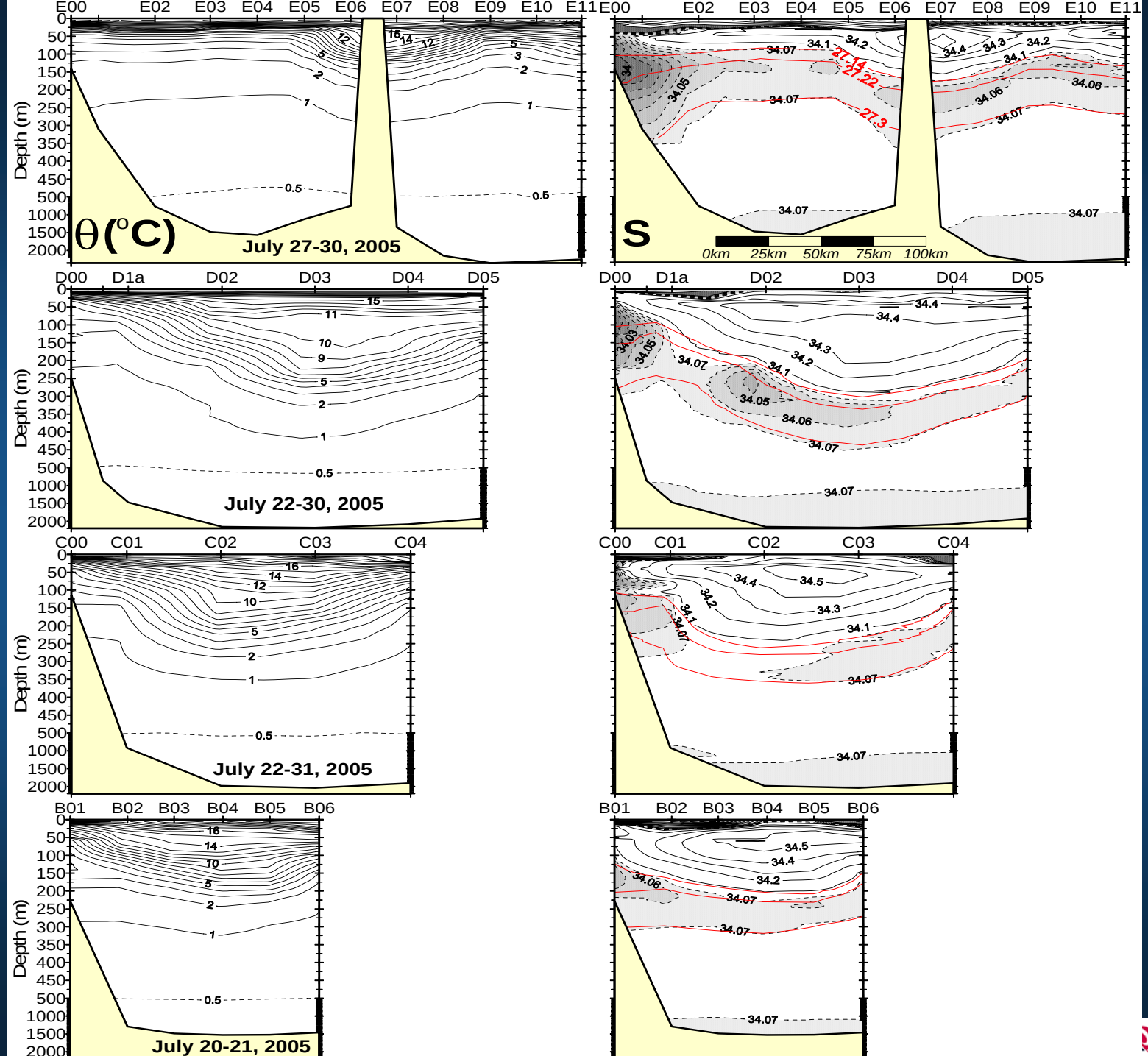
The feature of CHL and SST in July 2005

CHL

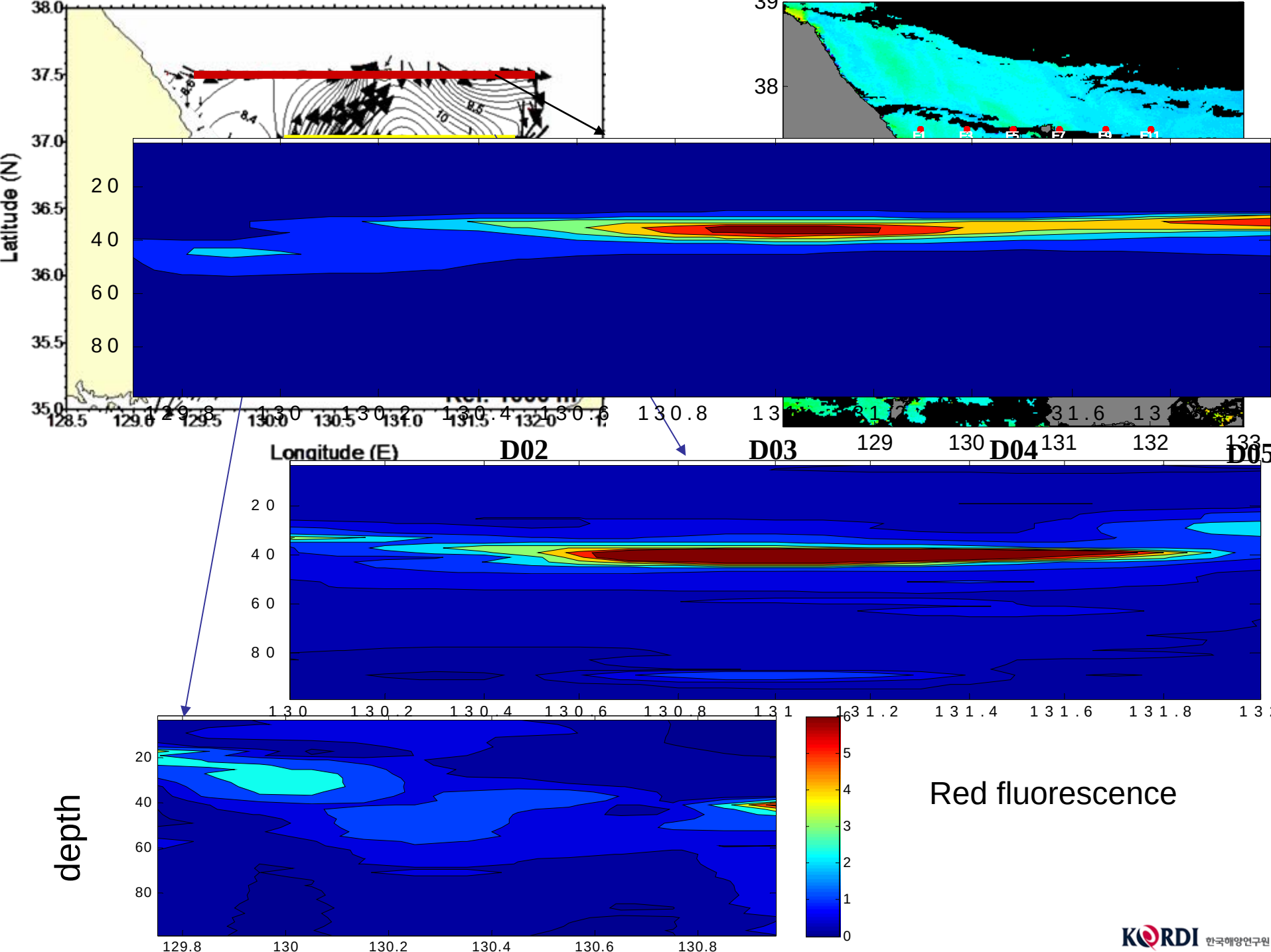


SST




θ(°C)
S
July 27-30, 2005
July 22-30, 2005
July 22-31, 2005
July 20-21, 2005
Depth (m)
E00 E02 E03 E04 E05 E06 E07 E08 E09 E10 E11
D00 D1a D02 D03 D04 D05
C00 C01 C02 C03 C04
B01 B02 B03 B04 B05 B06
0km 25km 50km 75km 100km
27.14
27.22
27.3

RDI 한국해양연구원


Latitude (N)
Longitude (E)
D02
D03
D04
D05
depth
Red fluorescence
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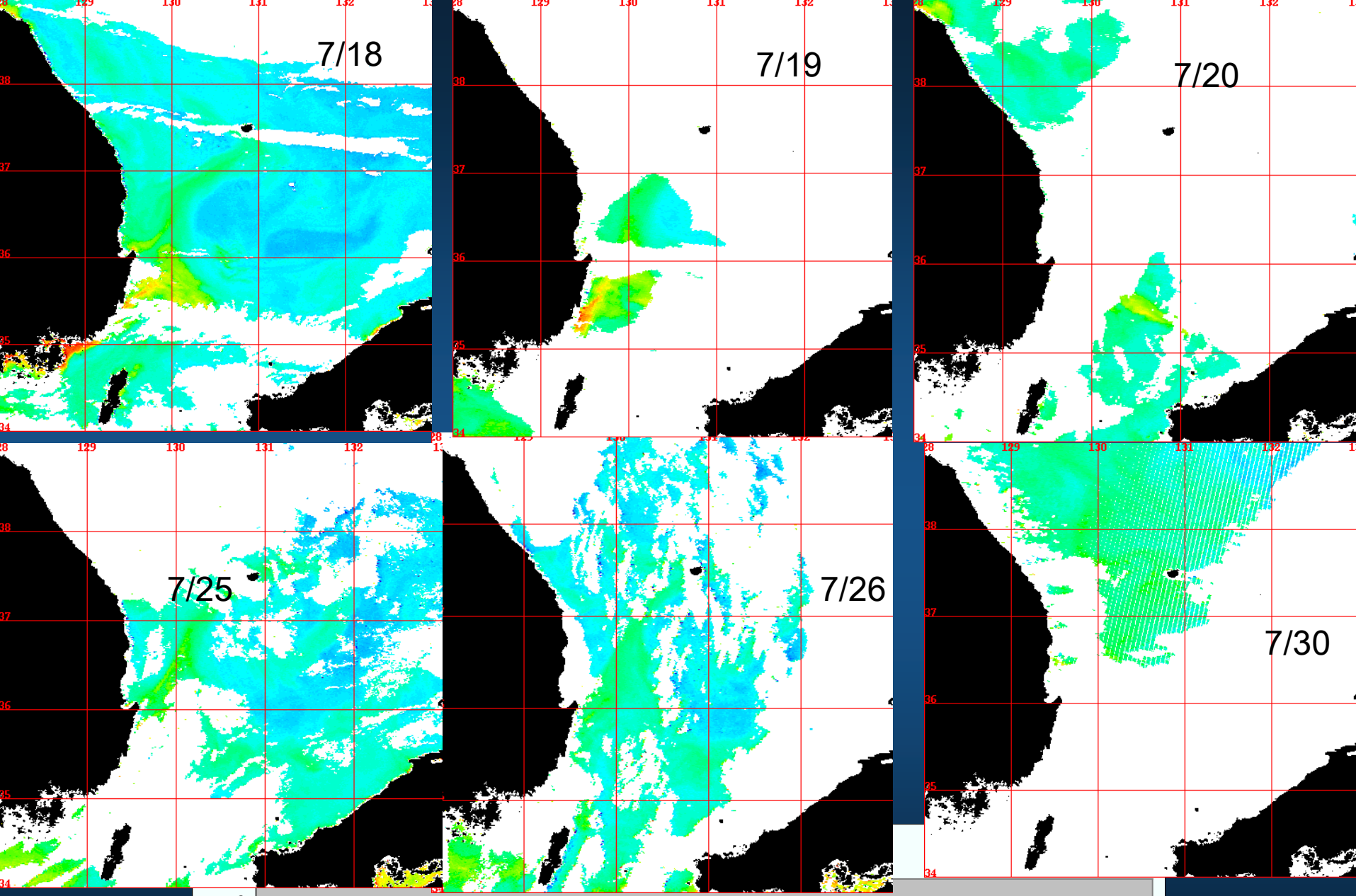
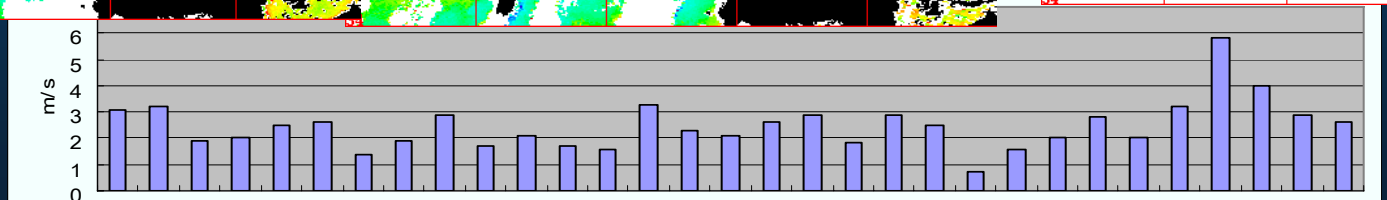
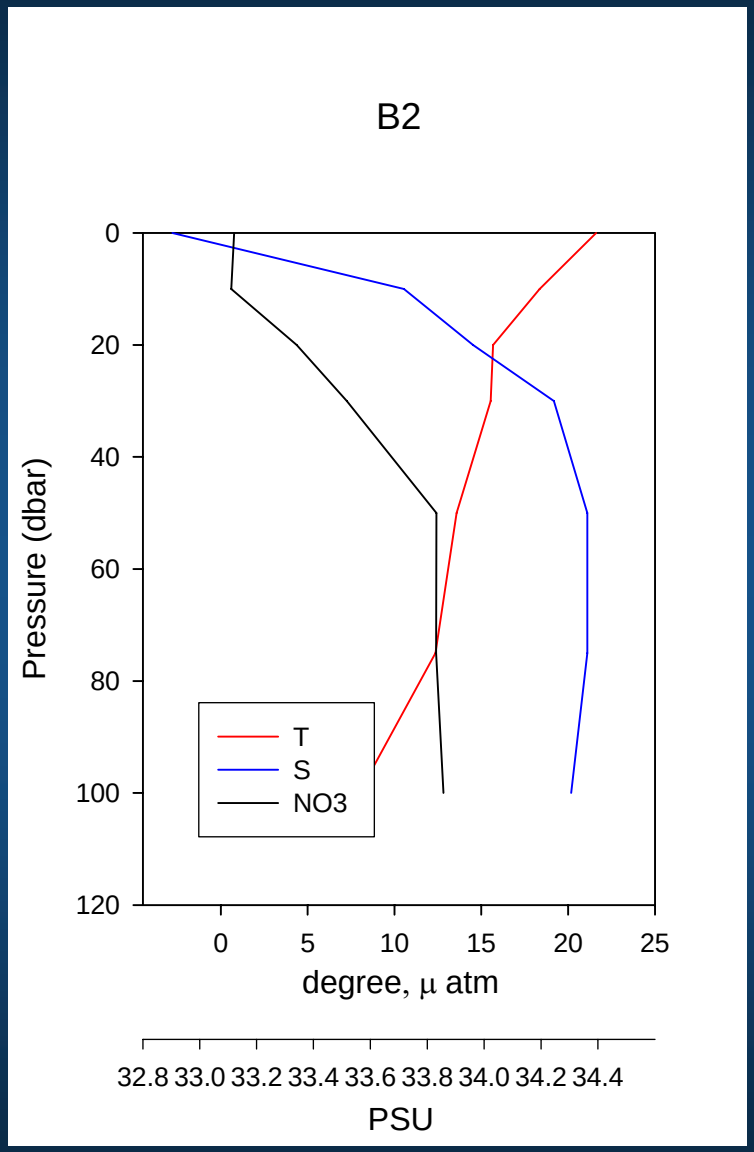
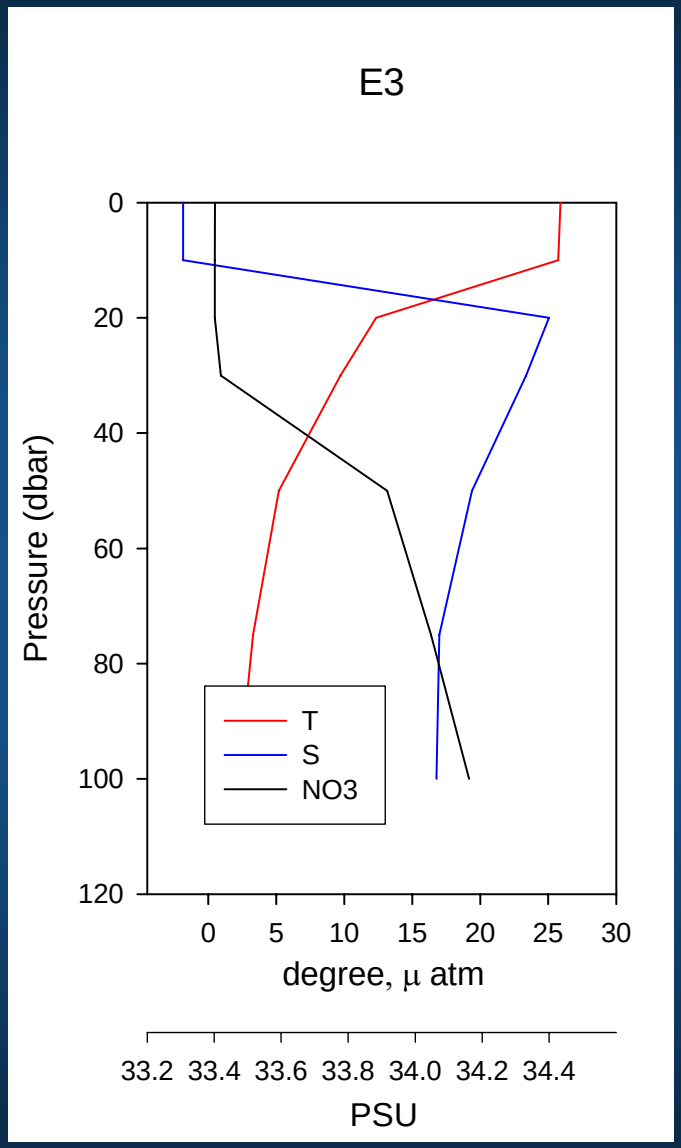
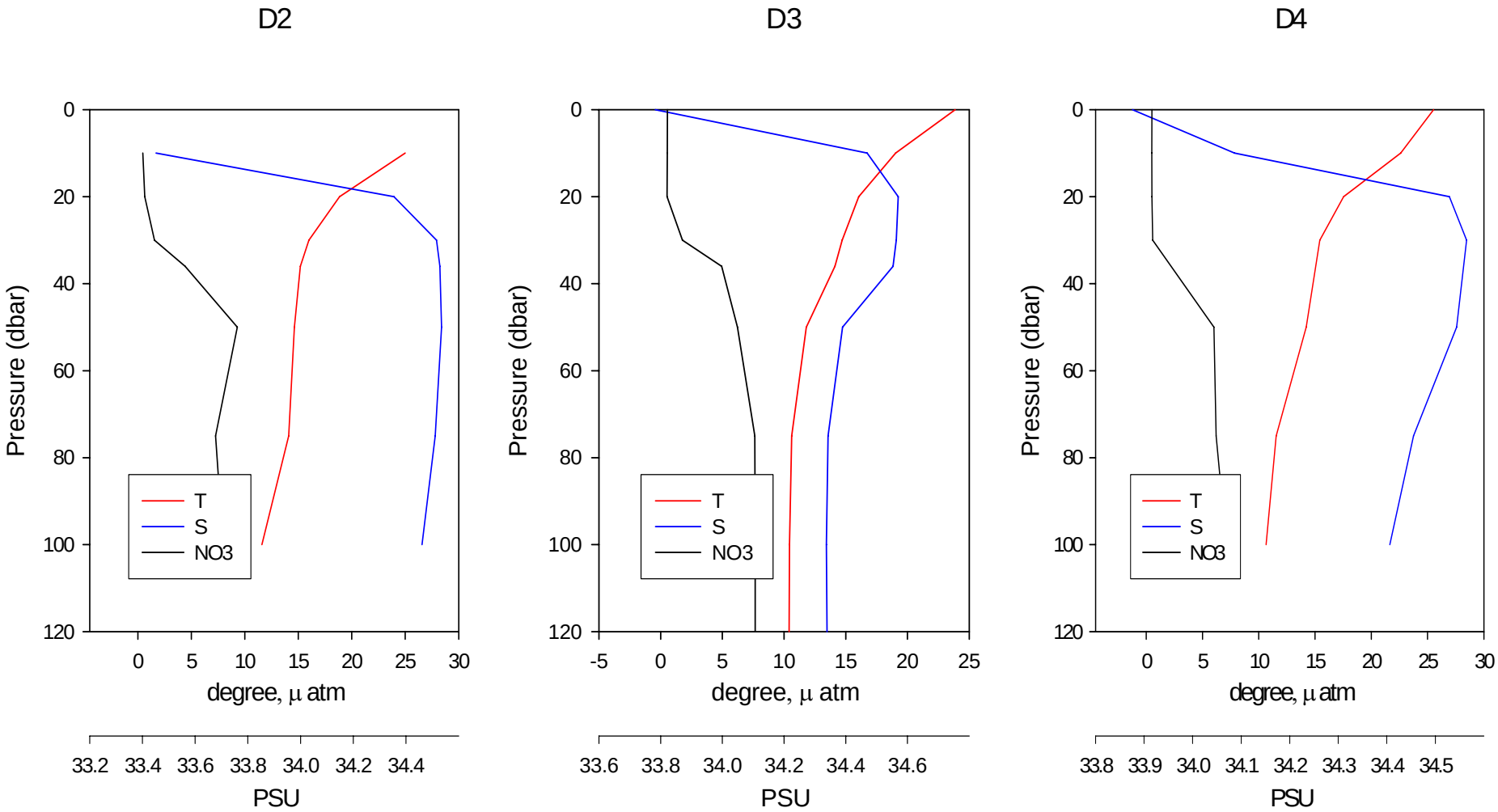
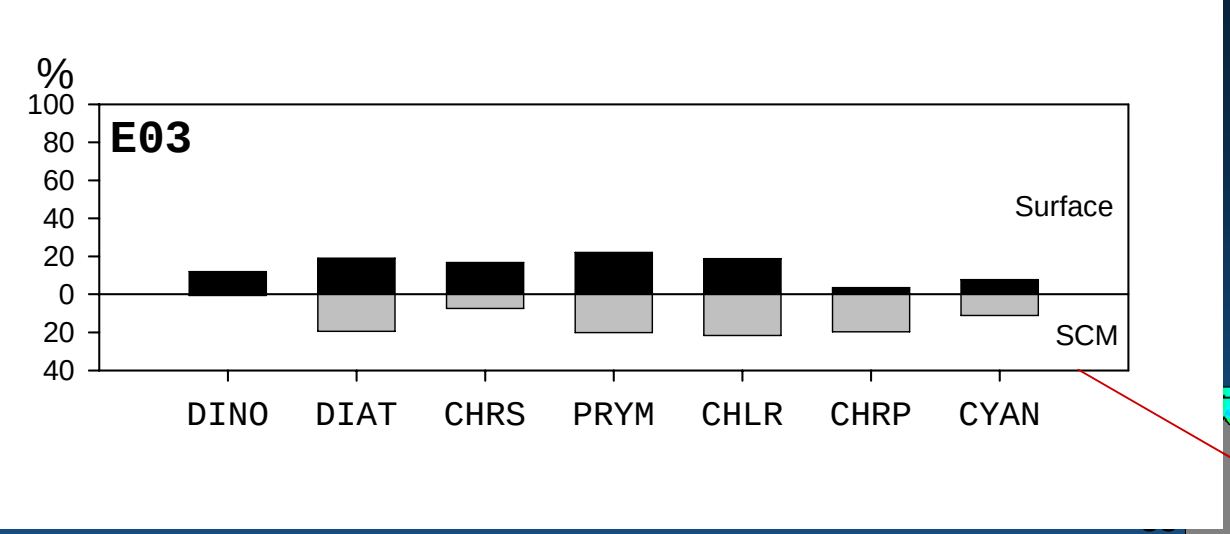




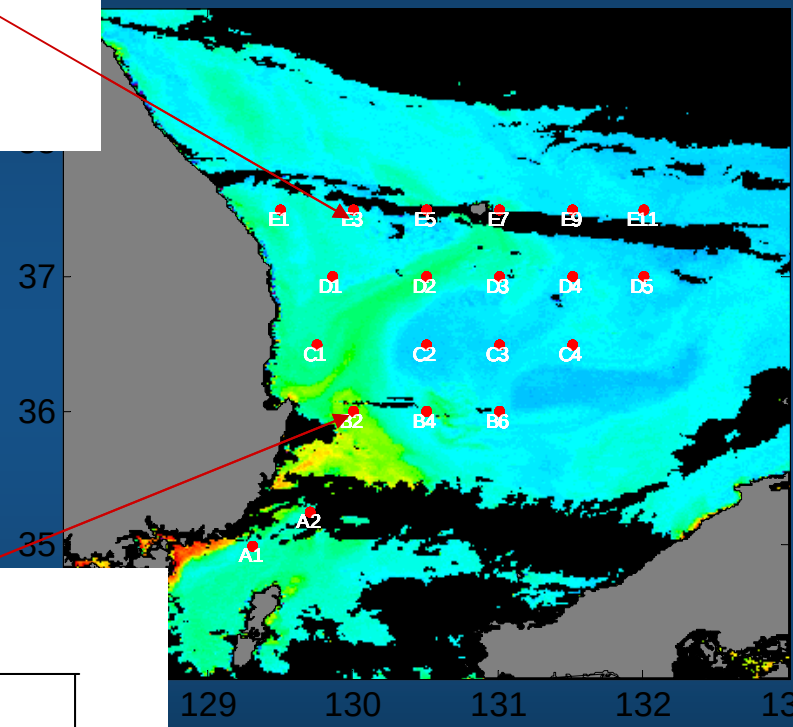


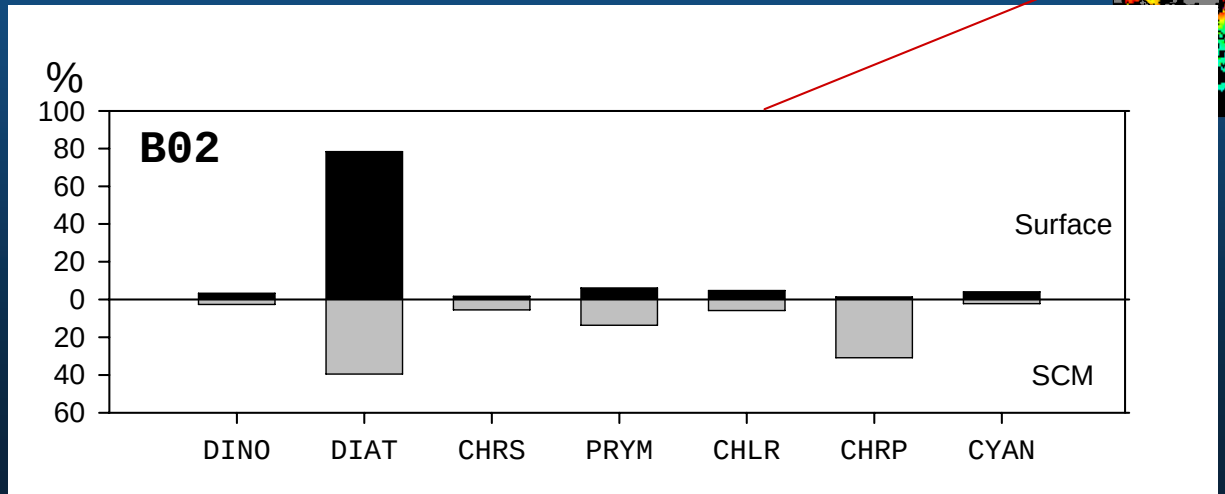


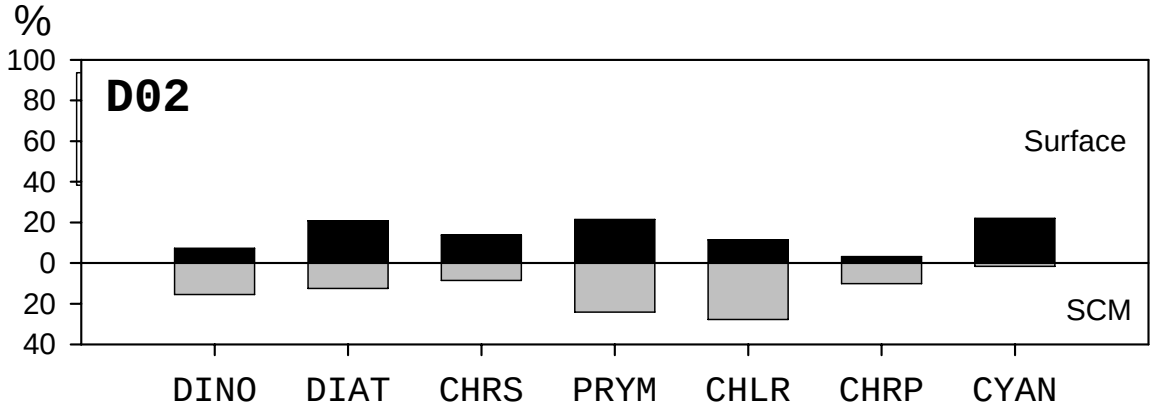


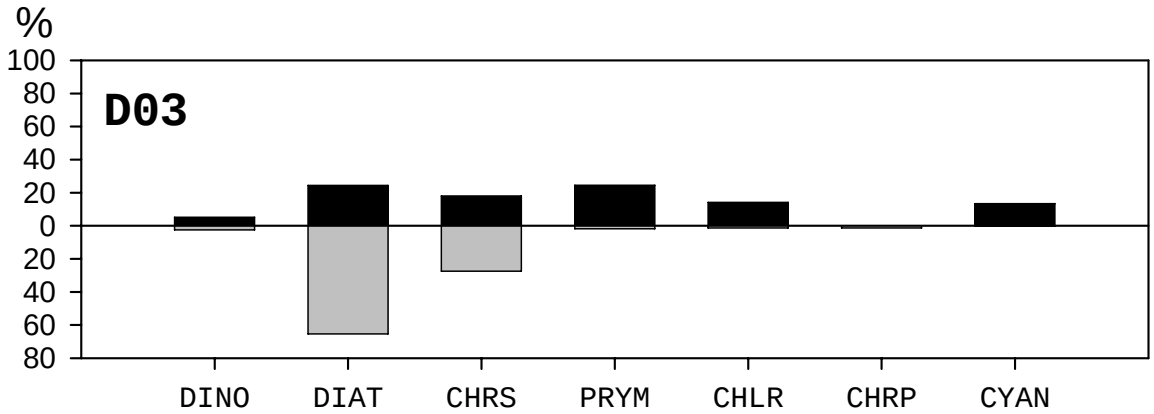


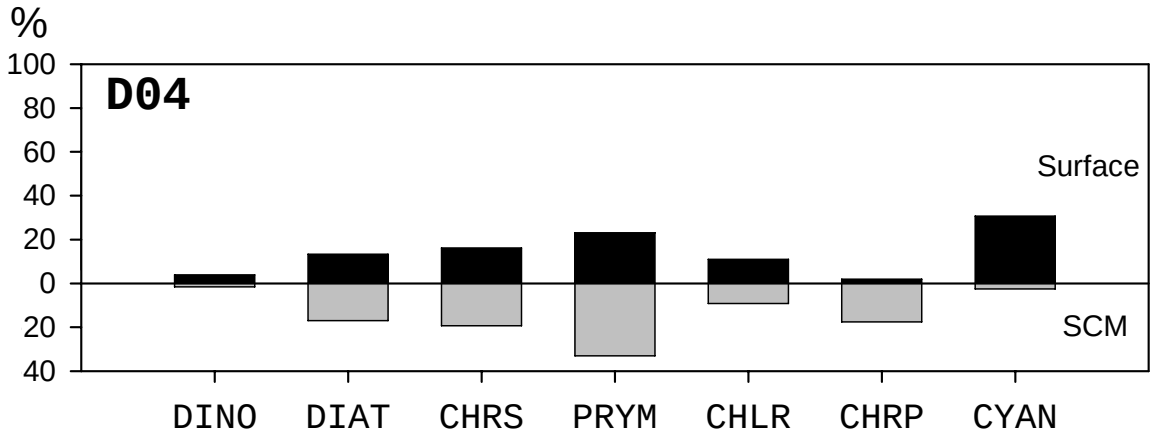
Phytoplankton composition by HPLC pigements (Chemtax)



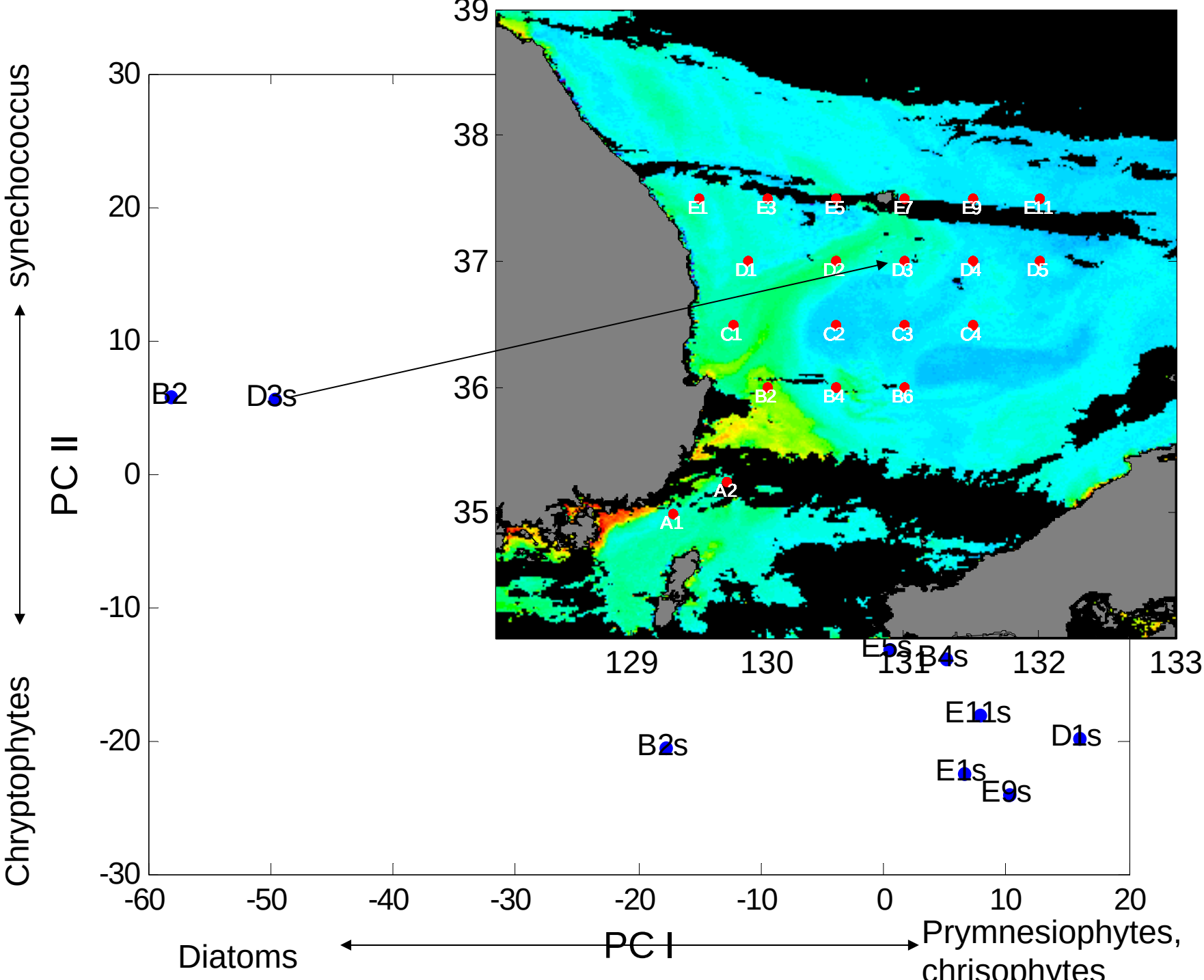


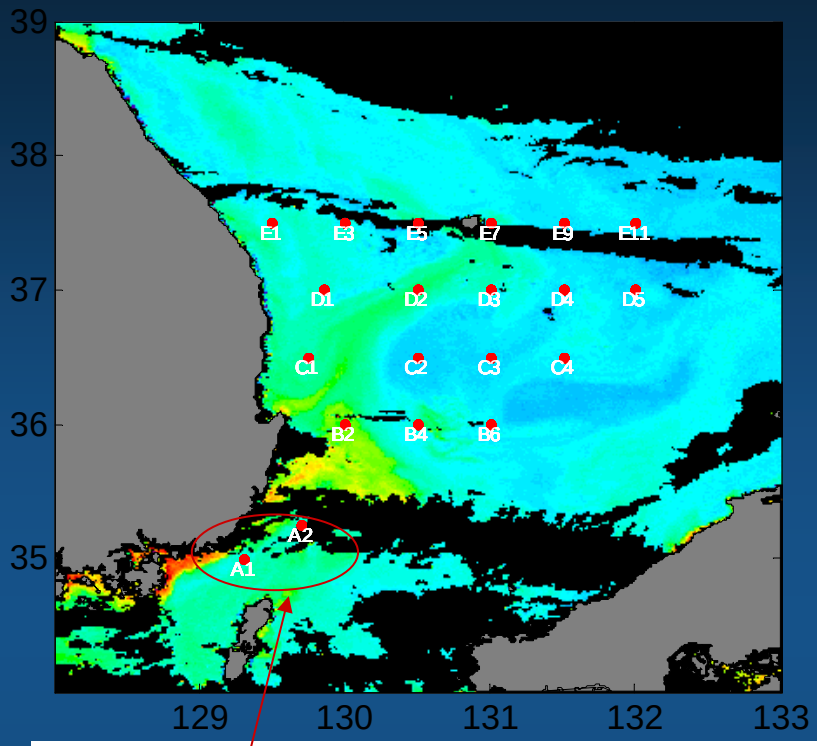


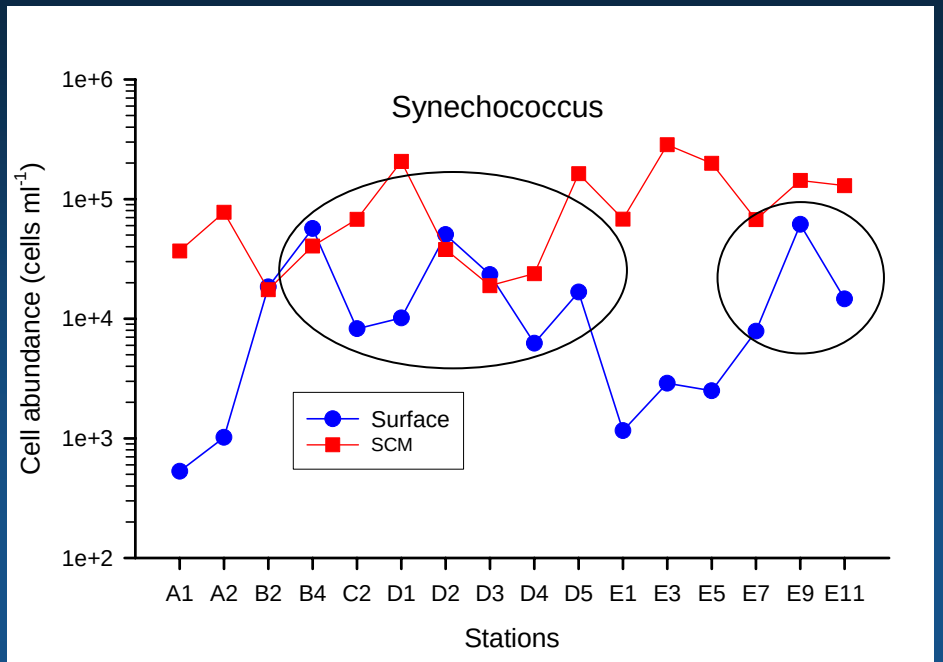


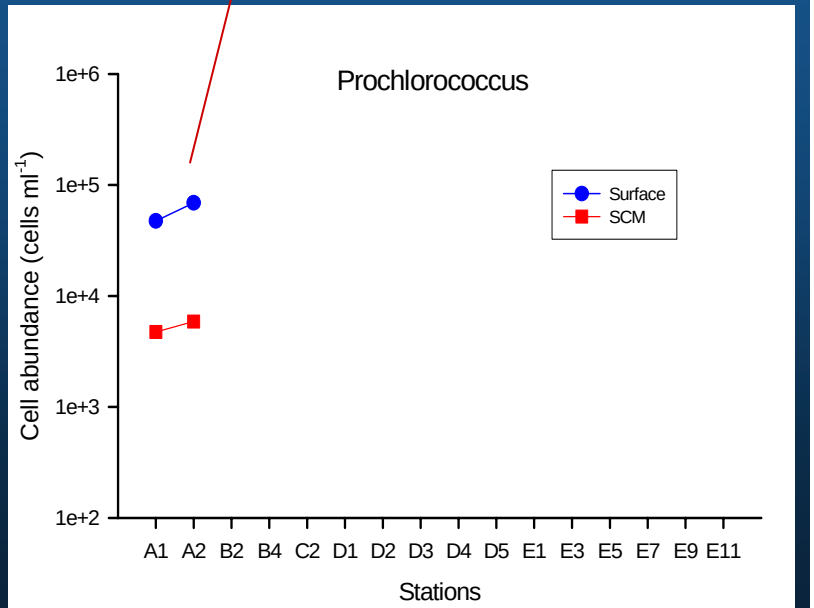


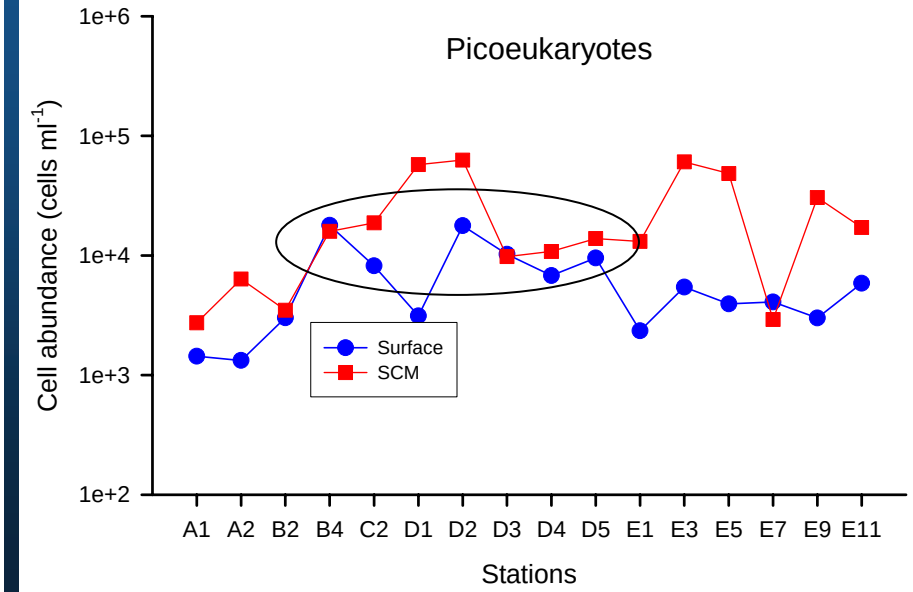
Phytoplankton composition by HPLC pigements

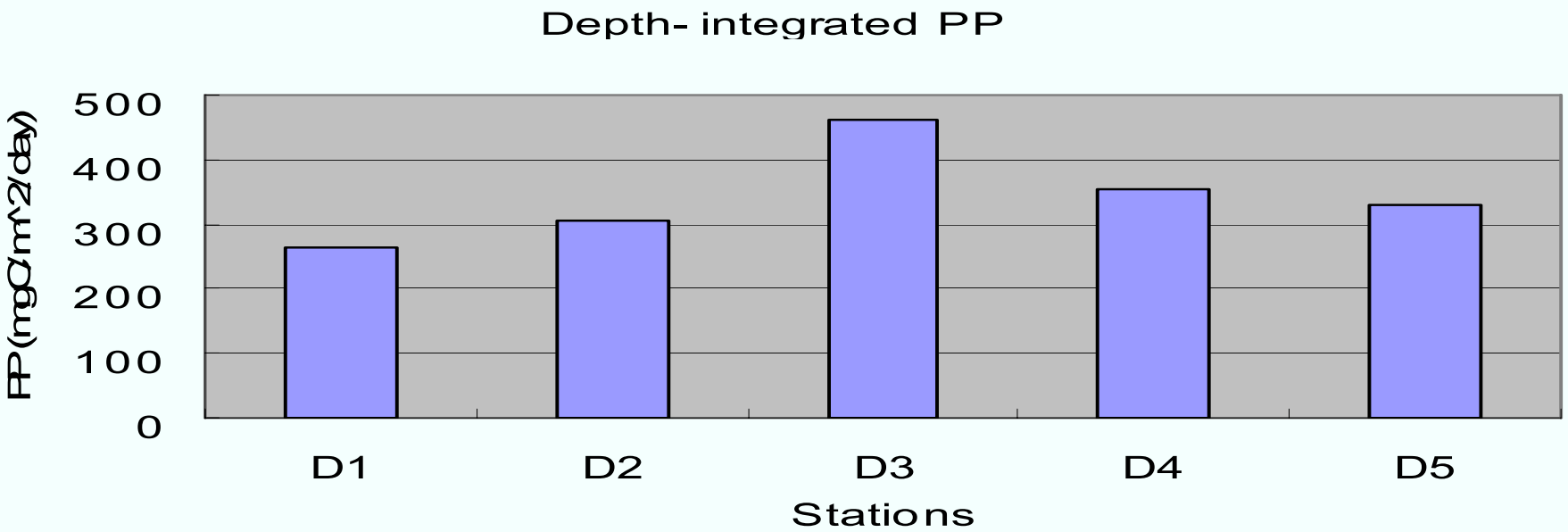

synechococcus
Chryptophytes
PC II
PC I
Diatoms
Prymnesiophytes, chrisophytes
30
20
10
0
-10
-20
-30
-60
-50
-40
-30
-20
-10
0
10
20
39
38
37
36
35
129
130
131
132
133
B2
D3s
E1
E3
E5
E7
E9
E11
D1
D2
D3
D4
D5
C1
C2
C3
C4
B2
B4
B6
A2
A1
E5s
B4s
E11s
D1s
B2s
E1s
E9s

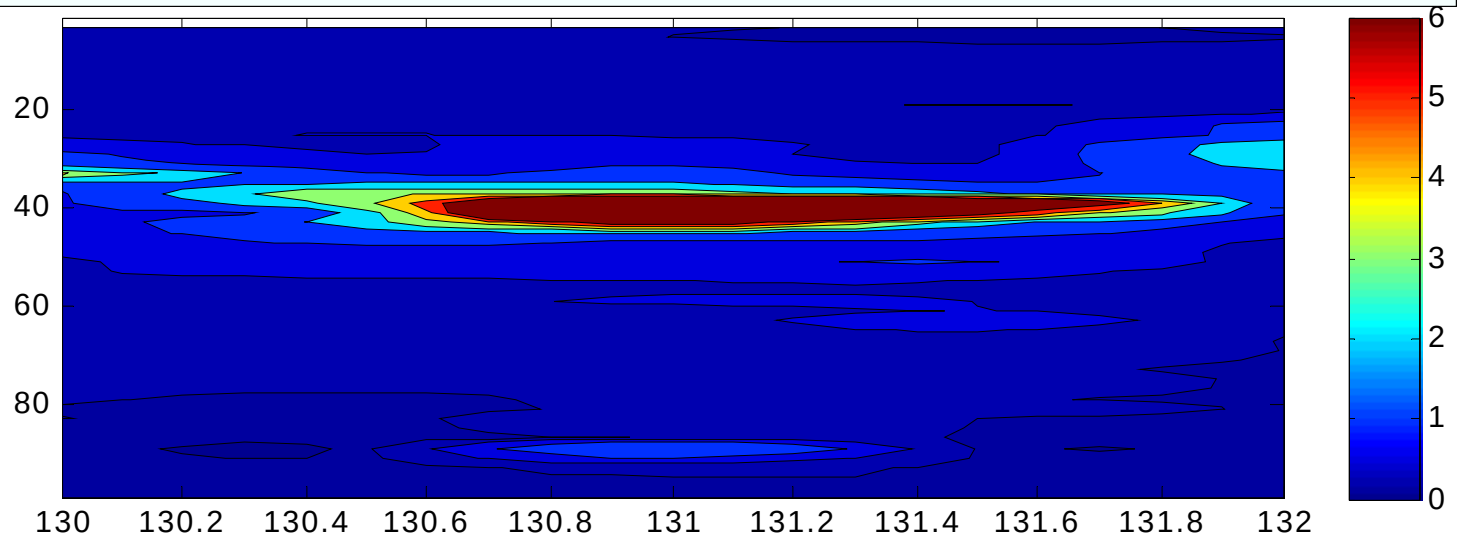

39
38
37
36
35
129
130
131
132
133
E1
E3
E5
E7
E9
E11
D1
D2
D3
D4
D5
C1
C2
C3
C4
B2
B4
B6
A2
A1


Synechococcus
Cell abundance (cells ml-1)
1e+6
1e+5
1e+4
1e+3
1e+2
Surface
SCM
A1 A2 B2 B4 C2 D1 D2 D3 D4 D5 E1 E3 E5 E7 E9 E11
Stations

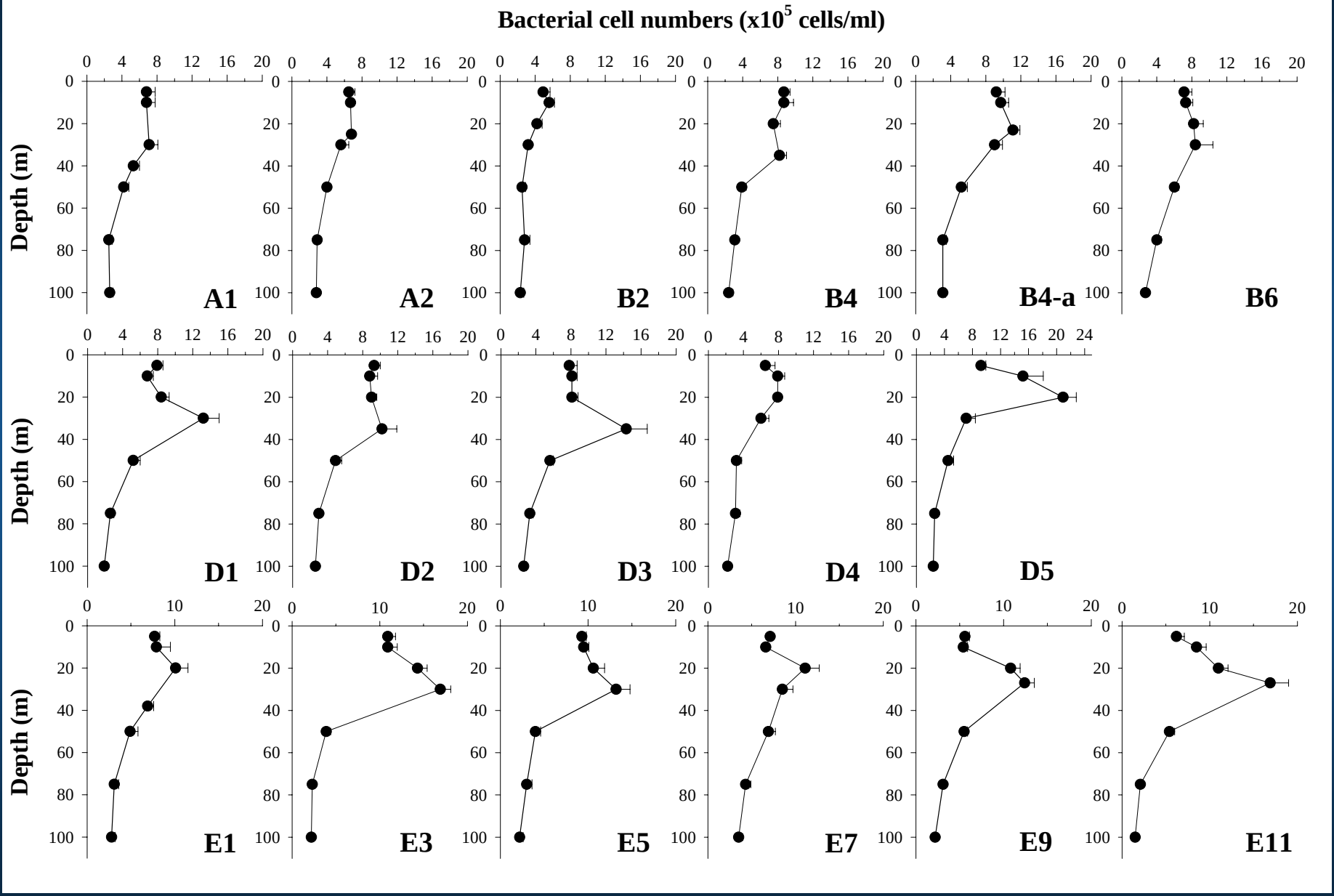

Prochlorococcus
Cell abundance (cells ml-1)
1e+6
1e+5
1e+4
1e+3
1e+2
Surface
SCM
A1 A2 B2 B4 C2 D1 D2 D3 D4 D5 E1 E3 E5 E7 E9 E11
Stations

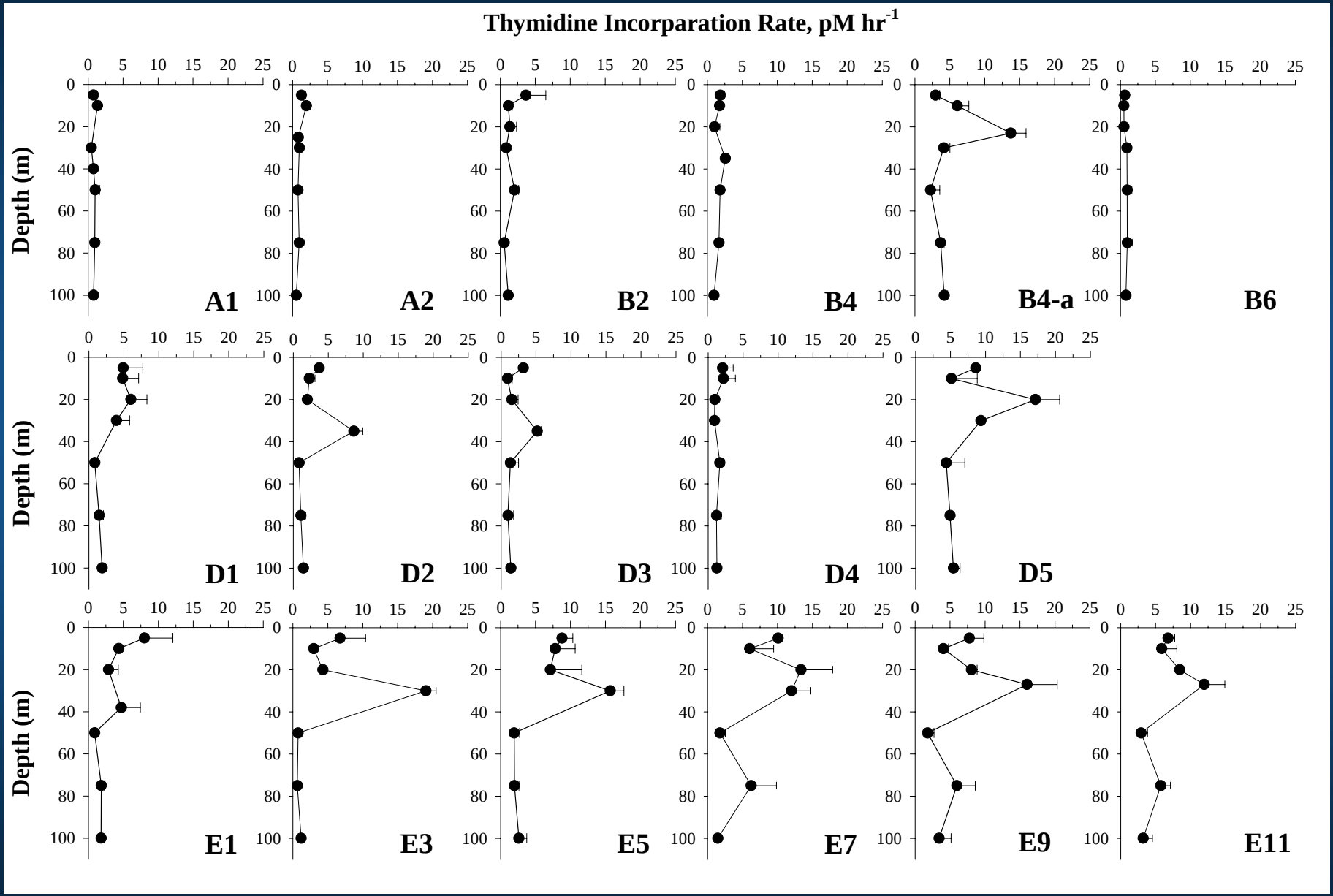

Picoeukaryotes
Cell abundance (cells ml-1)
1e+6
1e+5
1e+4
1e+3
1e+2
Surface
SCM
A1 A2 B2 B4 C2 D1 D2 D3 D4 D5 E1 E3 E5 E7 E9 E11
Stations

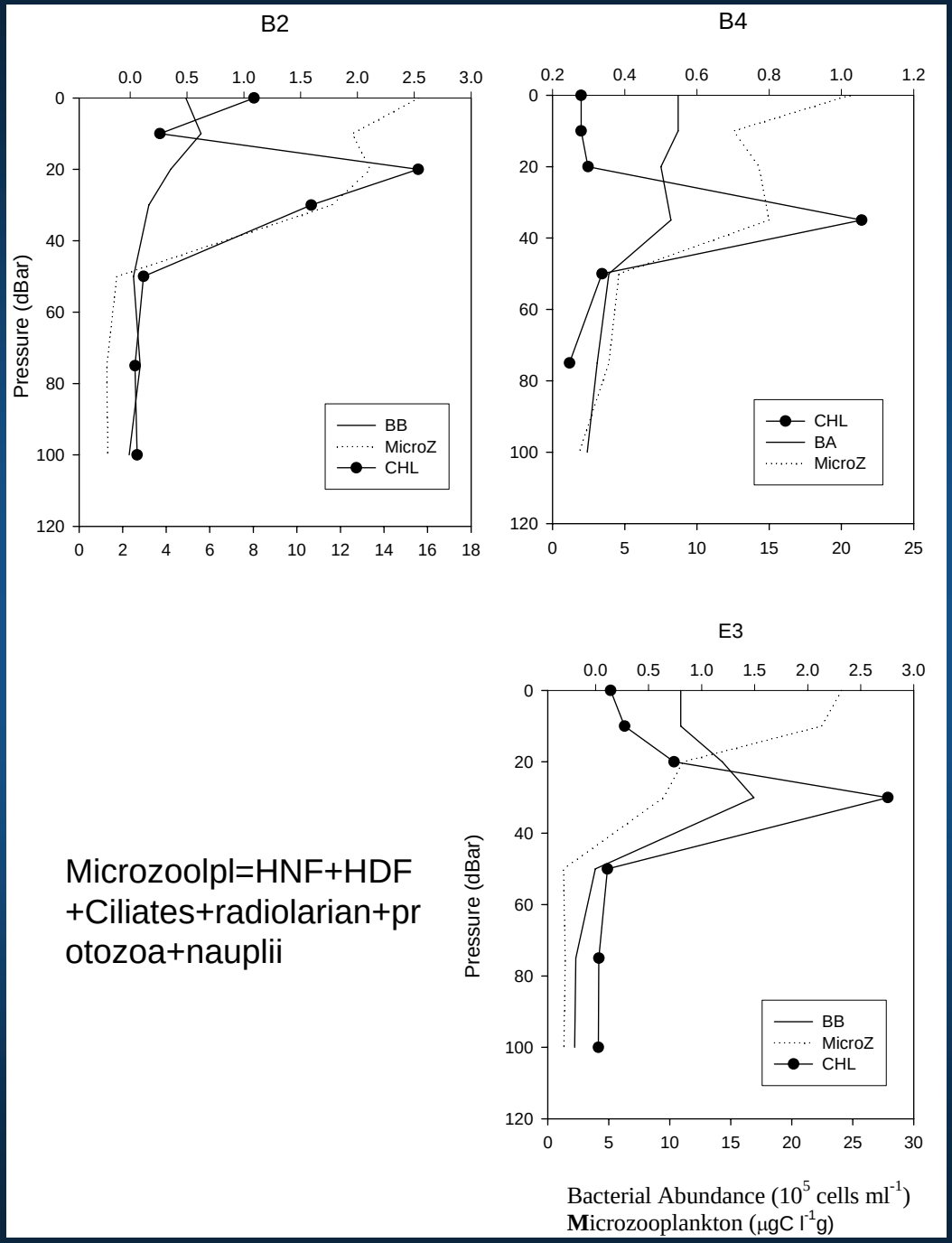




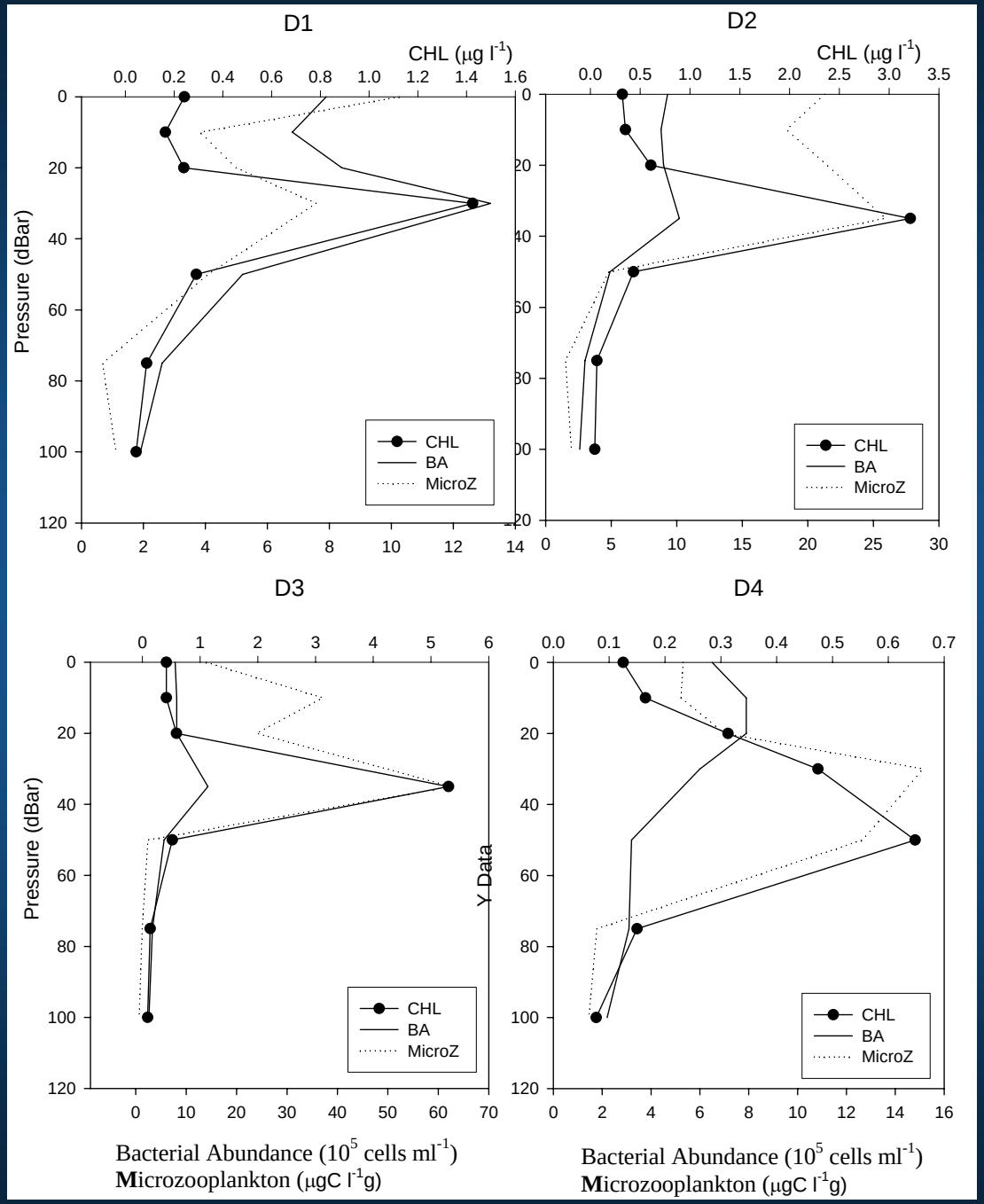
Red fluorescence



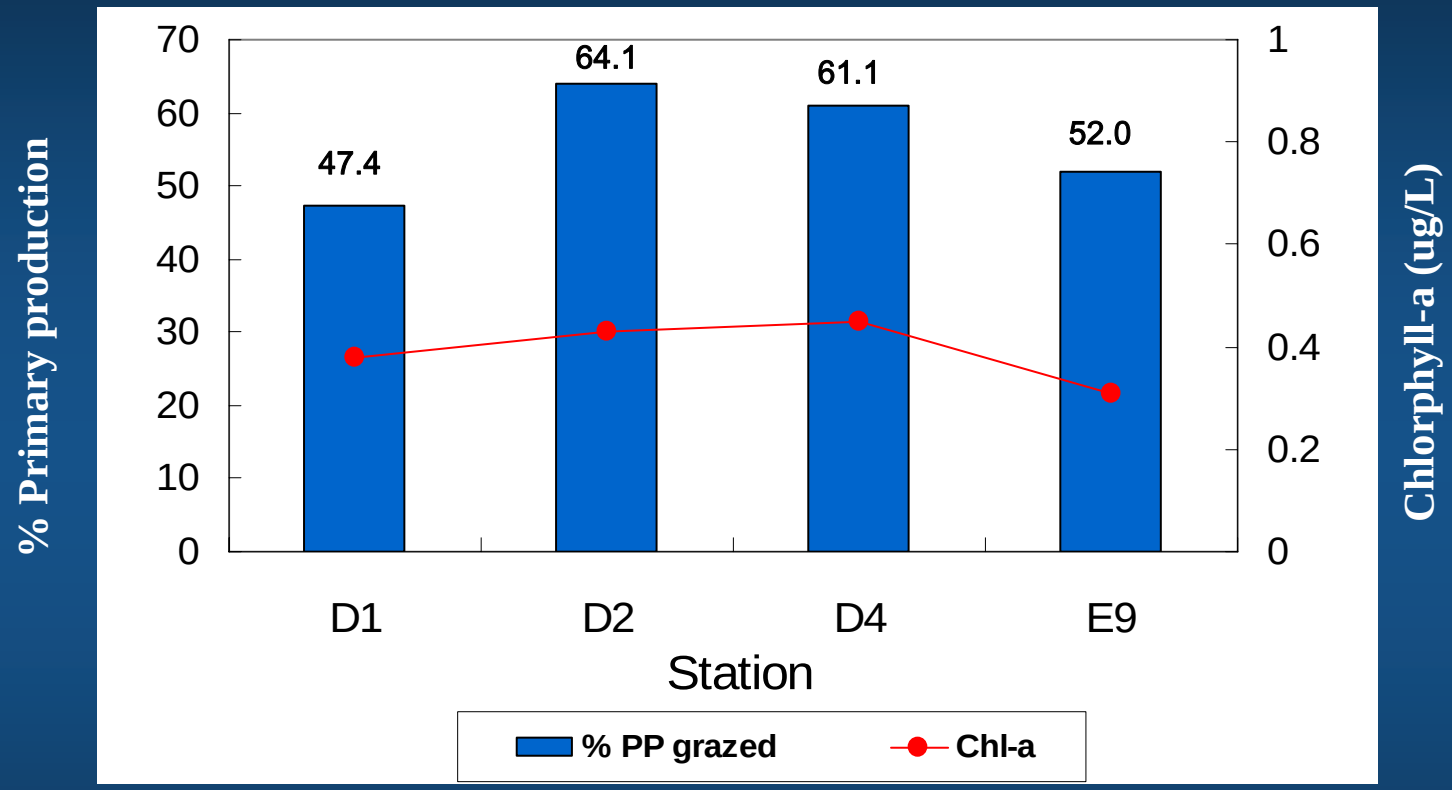




Microzoolpl=HNF+HDF+Ciliates+radiolarian+protozoa+nauplii

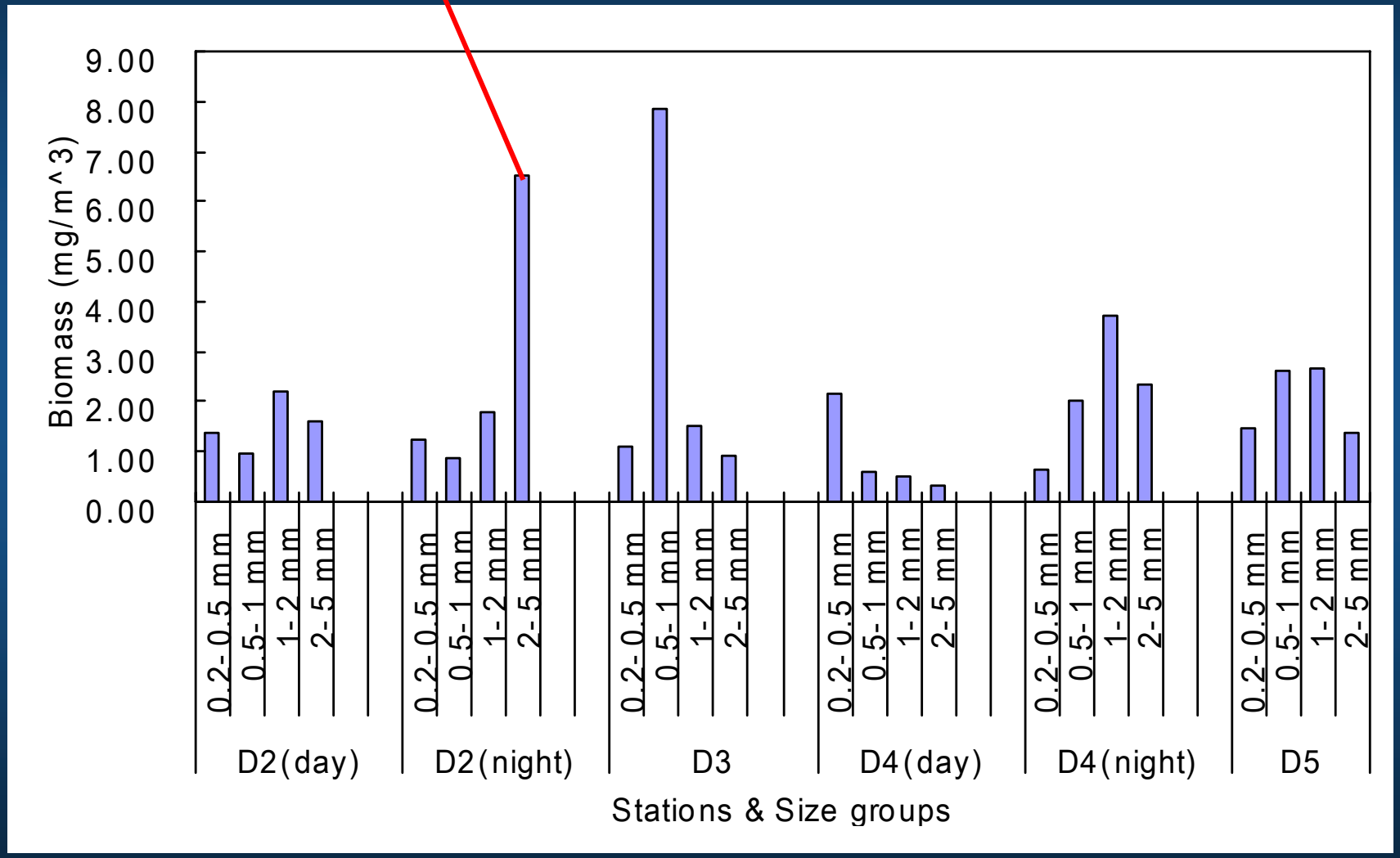


Grazing impacts of microzooplankton on phytoplankton

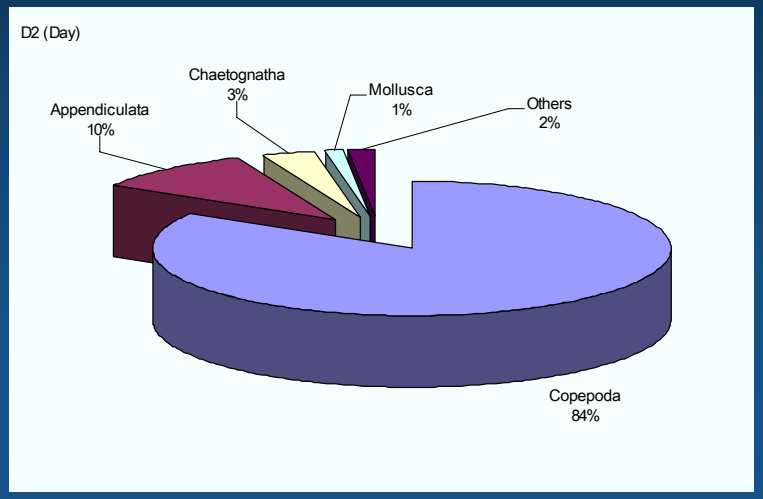


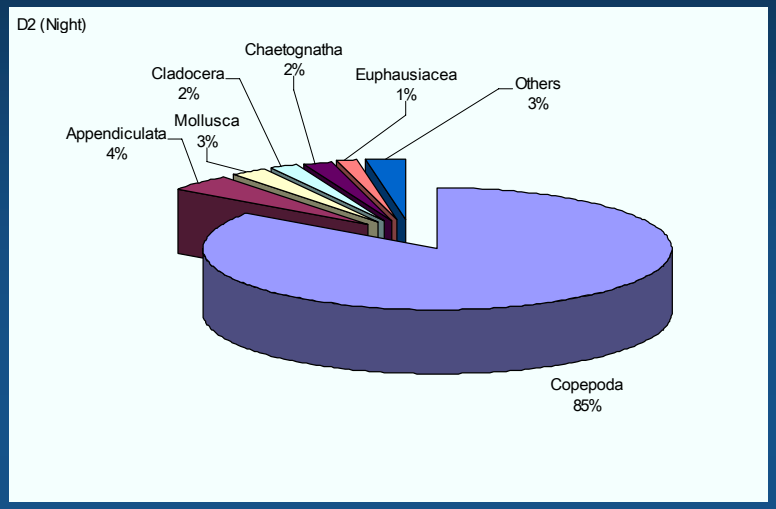
Size-fractionated mesozooplankton biomass (D line)

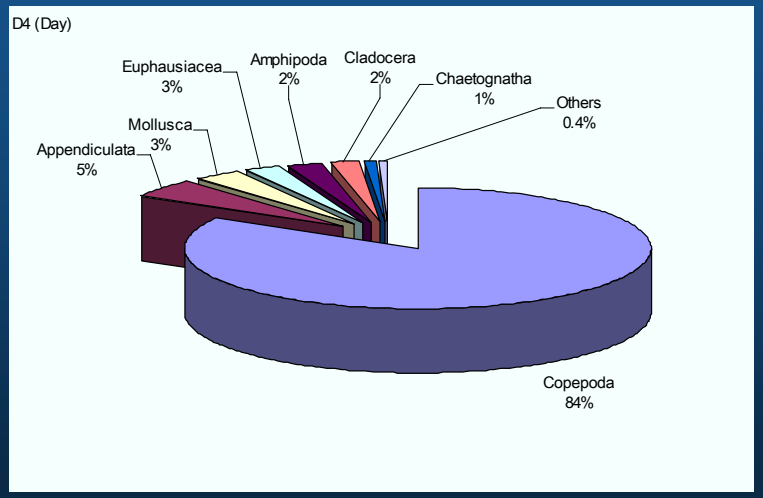
High density of amphipod in the trap sample !!

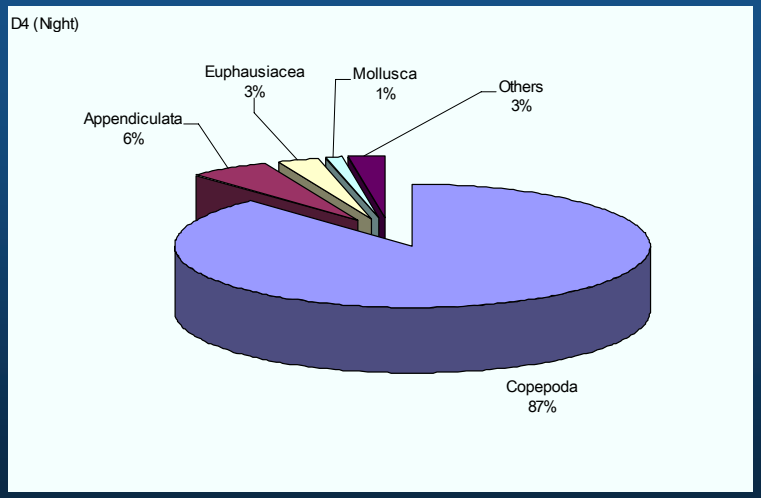


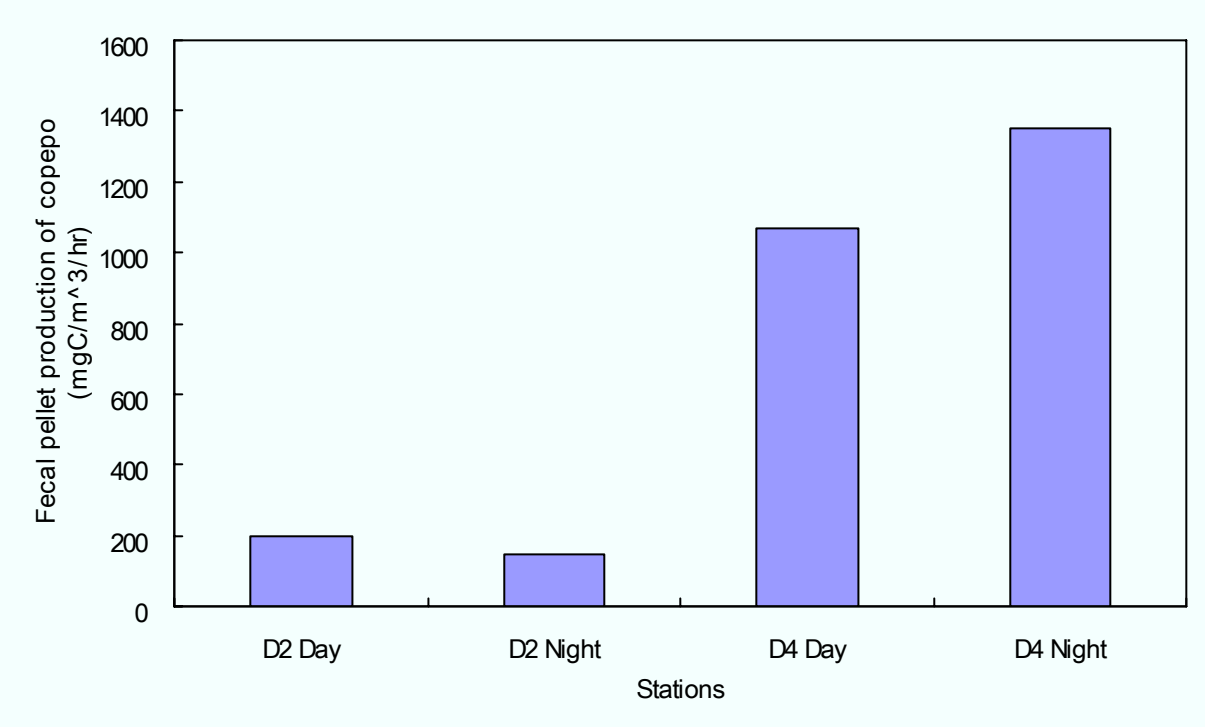
Mesozooplankton composition











Export production - sediment trap

D2

Depth (m)	Mass flux ($mgm^{-2}d^{-1}$)	POC (%)	POC flux ($mgm^{-2}d^{-1}$)	C/N
50	361	31	114	7.1
100	98	37	36	6.1
200	2050	48	977	7.4

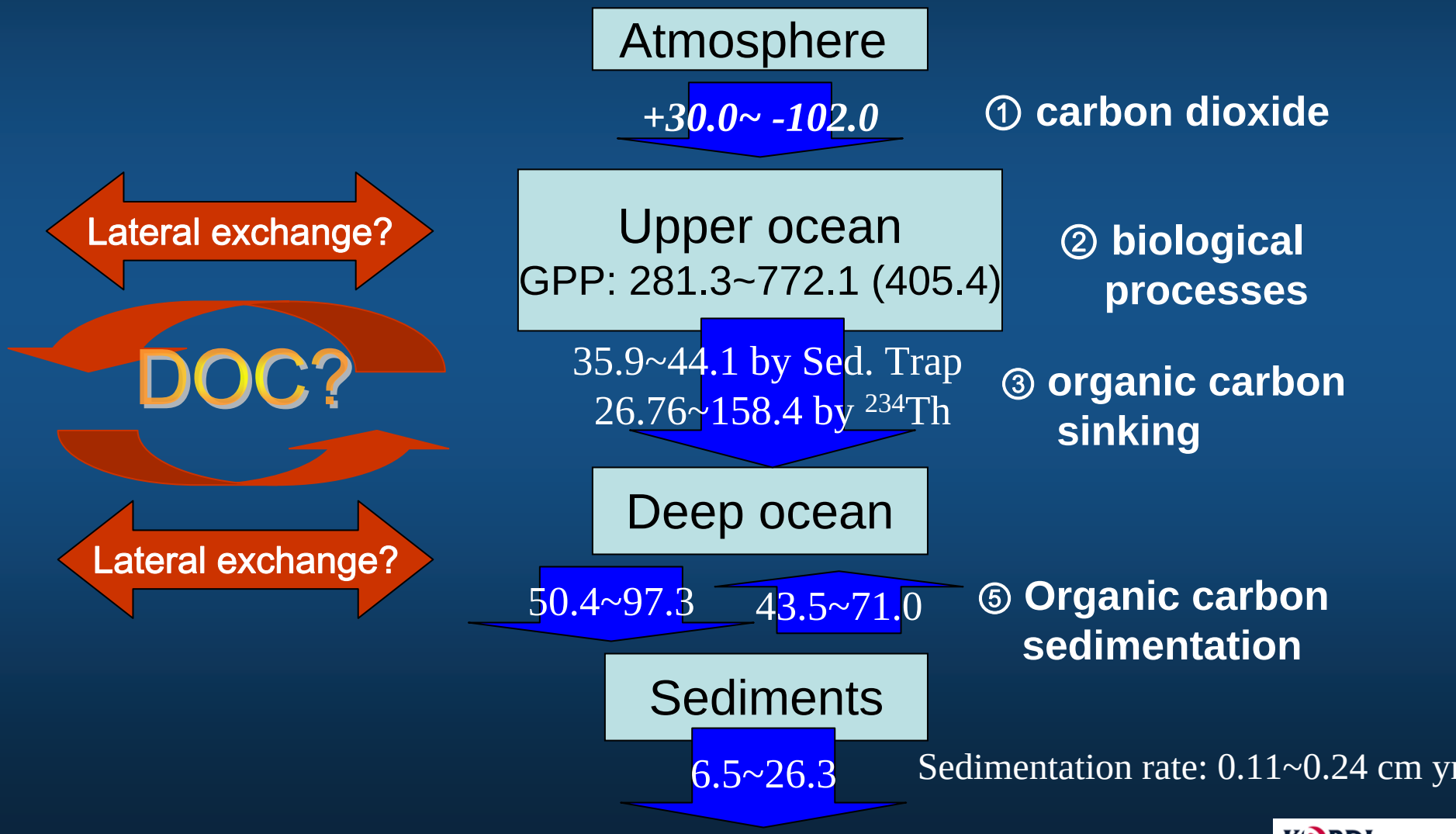
Export production(100 m) = 13.1 gC m^{-2} yr^{-1}

D4

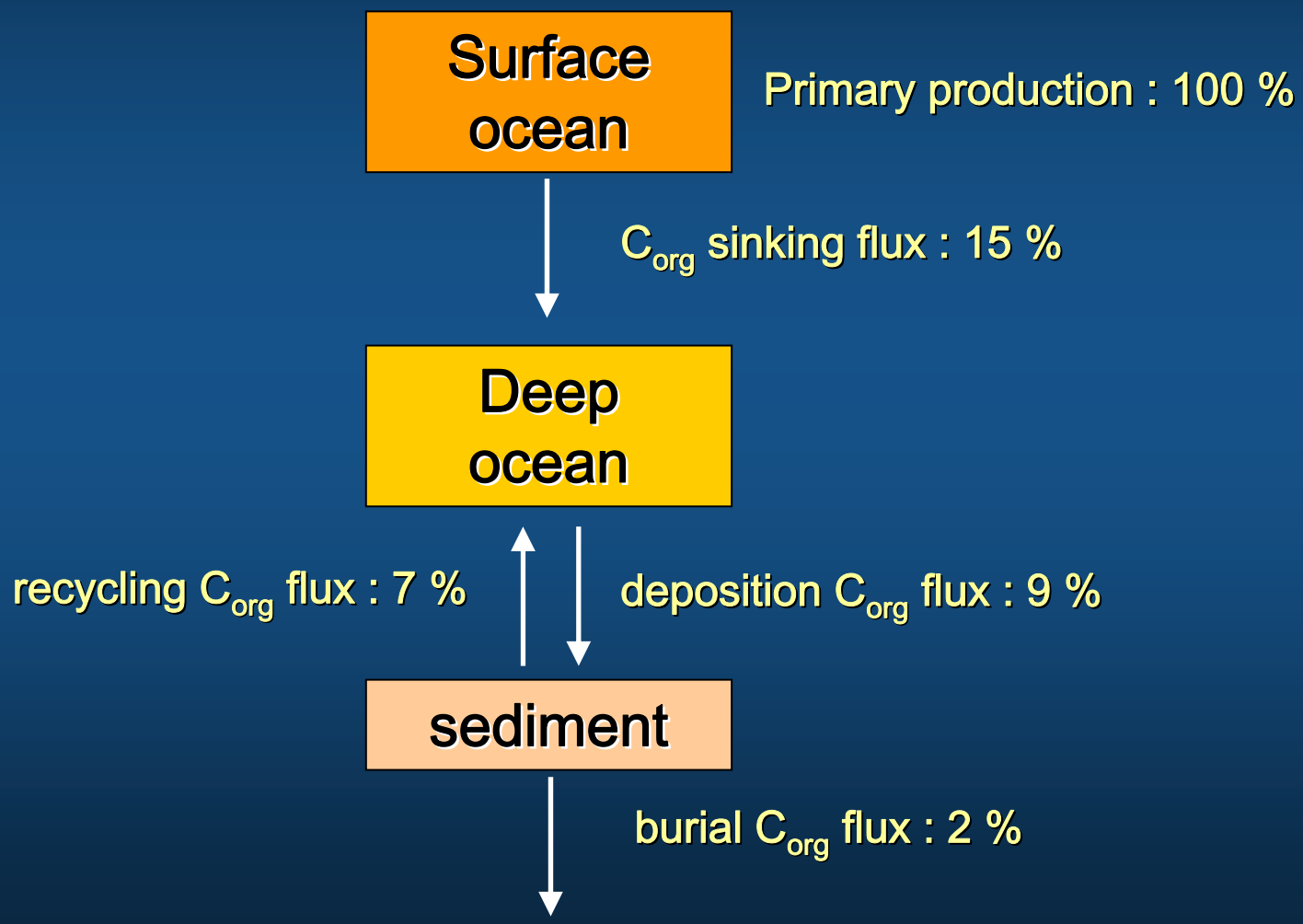
Depth (m)	Mass flux ($mgm^{-2}d^{-1}$)	POC (%)	POC flux ($mgm^{-2}d^{-1}$)	C/N
50	222	58	129	9.1
100	121	37	44	7.6
200	127	25	31	9.8

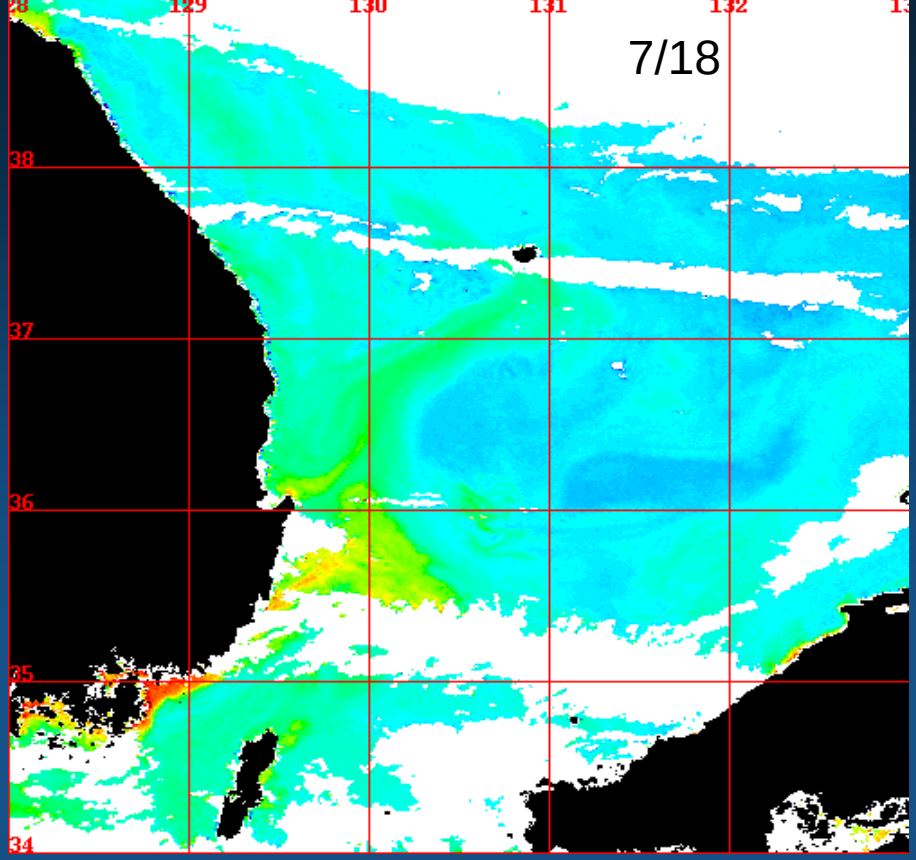
Export production(100 m) = 16.1 gC m^{-2} yr^{-1}

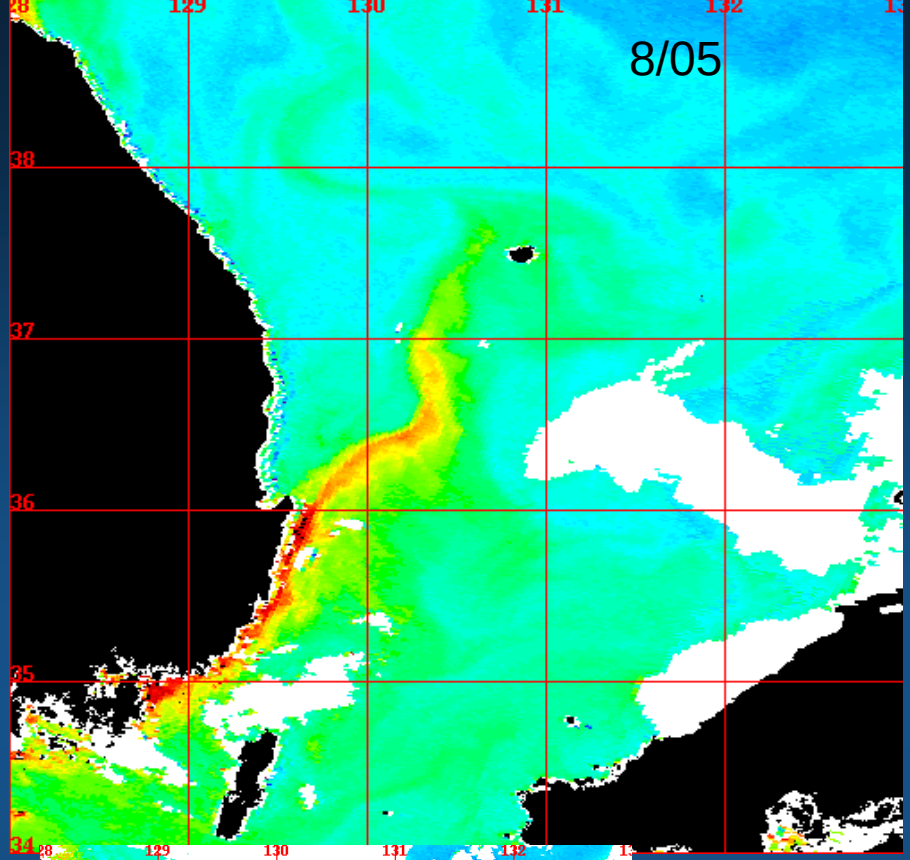
Summary of observation in 2005
(flux in mg C m^{-2} d^{-1})

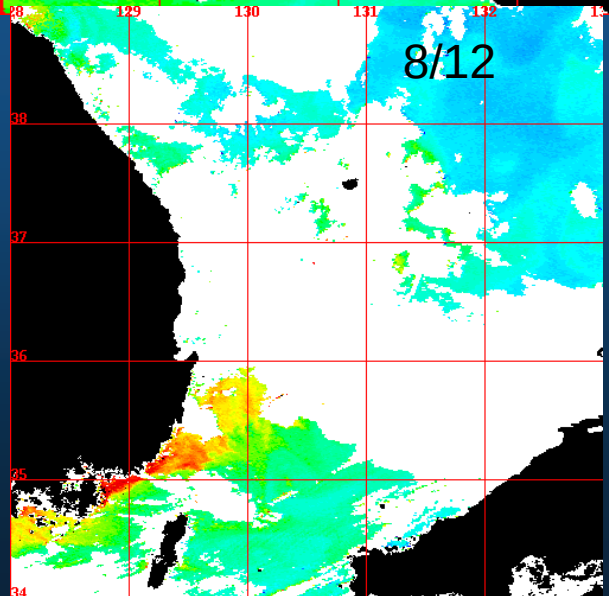


Organic carbon cycle in Ulleung Basin









Summary

- Intermittent coastal upwelling influences the phytoplankton communities in the Basin.
- Primary production ranged 281~772 mg C m^{-2} d^{-1} and was lower in the eddy. Within the eddy system, it was higher in the center due to pronounced subsurface chlorophyll maximum.
- Northern area showed higher bacterial abundance and production, which is not explained yet. In most stations, bacterial abundance, chlorophyll, and microzooplankton biomass showed a good relationship.
- Fecal pellet production was higher inside the eddy than that in the periphery which is consistent with PP and the sinking rate measured from a drifting sediment trap.