

DEVELOPMENT OF WATER COLUMN SAMPLER FOR THE STUDIES OF MICRO-SCLAE VERTICAL STRUCTURE IN THE LAKE

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Importance of knowledge of ecosystem function in lake

- Knowledge of function of ecosystem is required to manage the condition of lake.
- But, Its function is very complex.

Two ways of monitoring of properties in the lake

- Sensors

CTD with fluorometer and turbidity meter

Salinity, Chlorophyll a, SPM(Suspended particulate matter)

Irradiance, shear probe pH, DO meters

- Sampling

Phytoplankton, pollutants, nutrients, size spectrum of SPM

Laboratory analysis is required.

There is a gap between sampling and measurements by sensor

- With fluorometer and turbidity meter, we can measure vertical distribution. But what is the causative agent remains unknown.

Variation of Phytoplankton

(Species, sizes , sinking velocities)

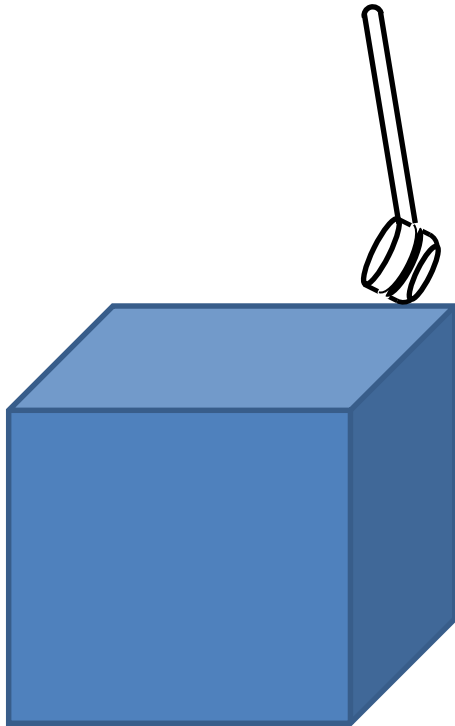
Variations of SPM

(Inorganic , organic , fragile)

- With sampling, we can analyze properties of sea water, but the number of sampling is limited.

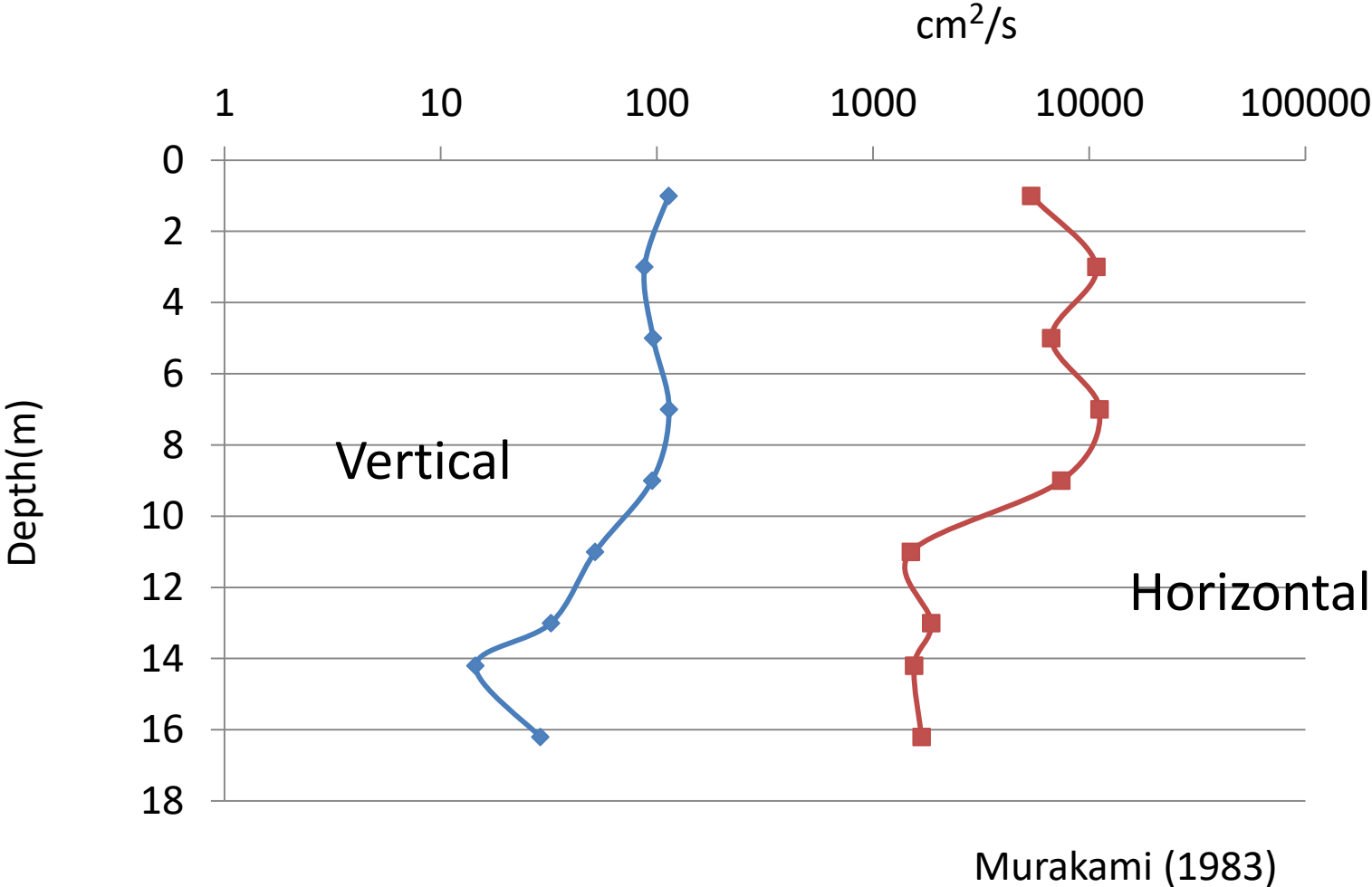
How representativeness is ensured

If homogeneity is ensured, you can sample water from any point.

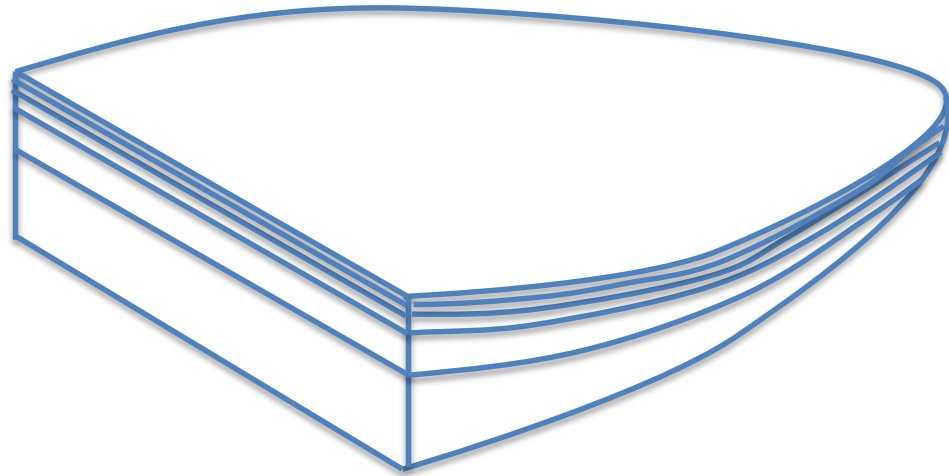
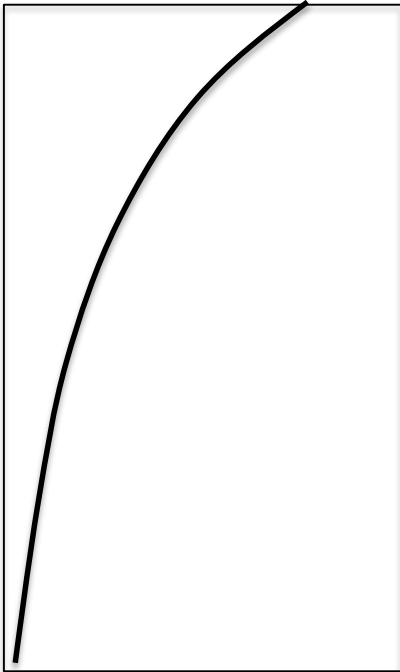


Lake

Directional Difference in diffusion coefficient

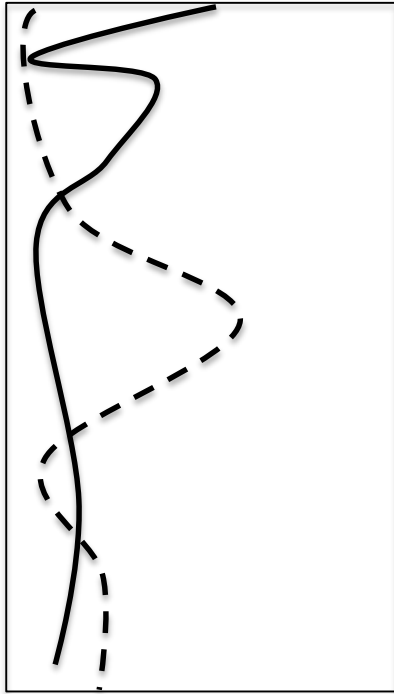


Environmental condition in lake is
Depth dependent.



Lake has a layered
structure like a cake

Ecological phenomena is depth dependent



n: solid line
m: broken line

$$\begin{aligned} \frac{dn(z)}{dt} \\ = f(m(z))n(z) \end{aligned}$$

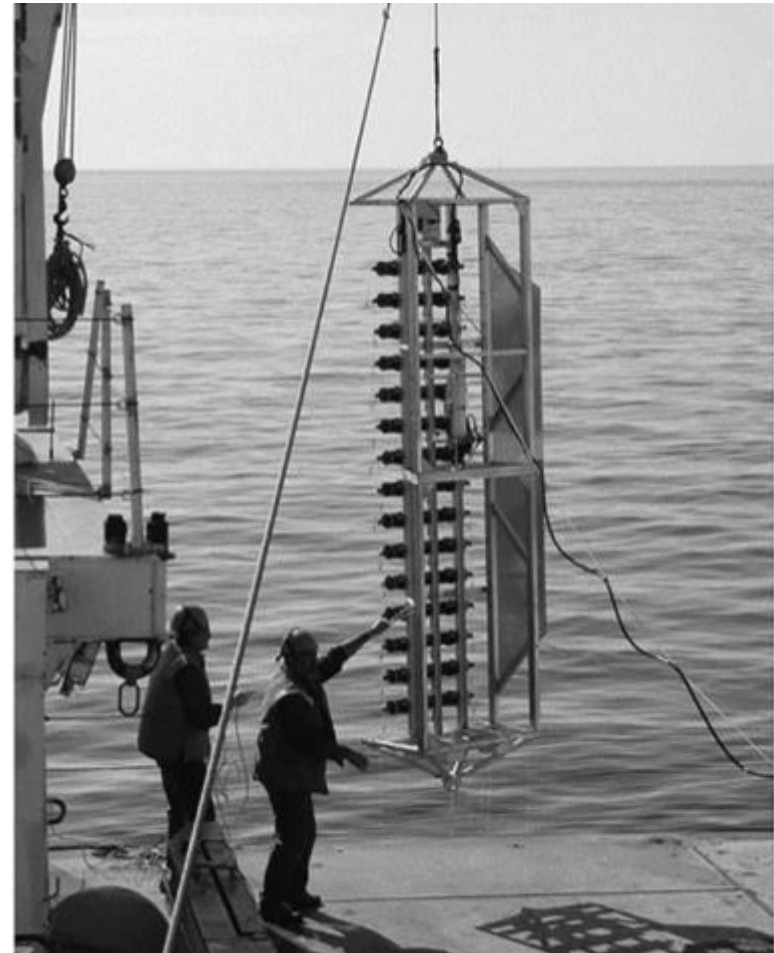
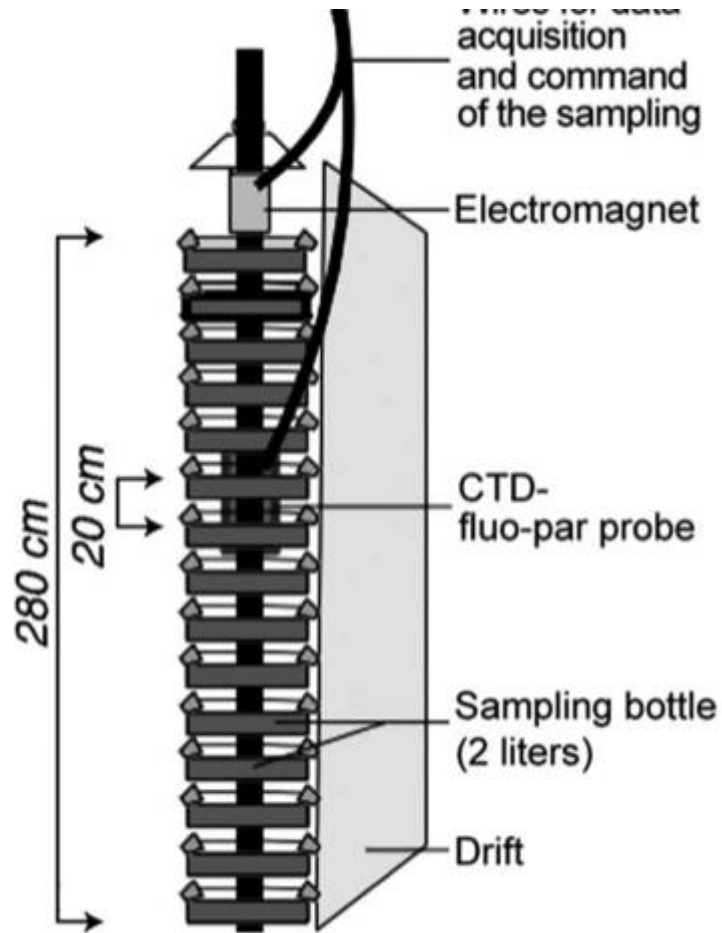
$$\frac{d\left(\int n dz\right)}{dt}$$

$$\neq f\left(\frac{1}{Z} \int m dz\right) \int n dz$$

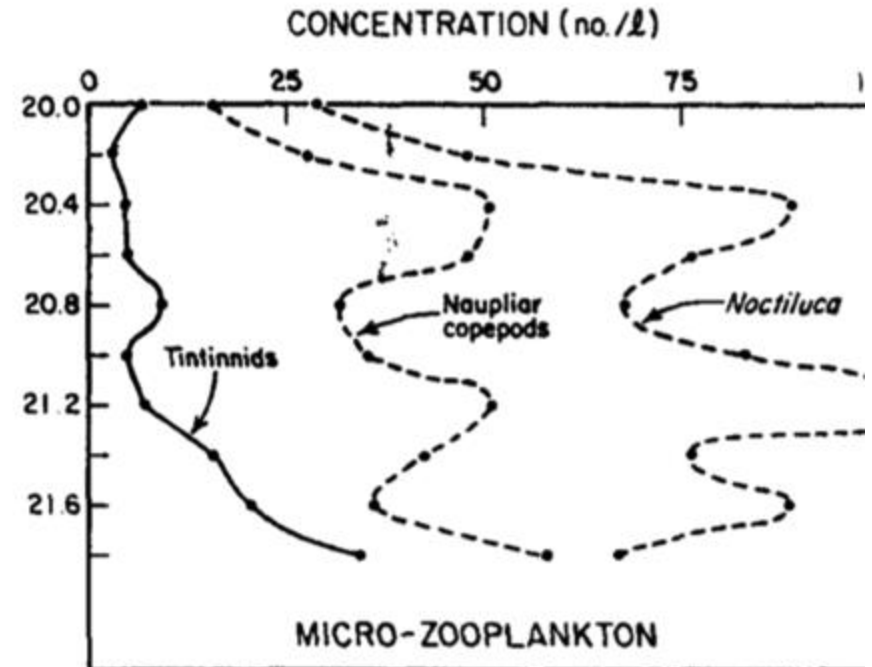
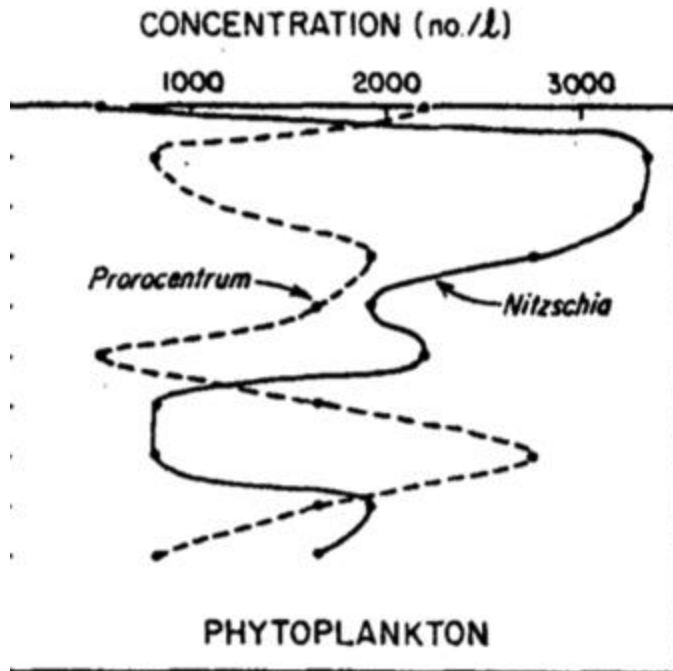
To make a still image of lake environment into movie

- Importance of 4 dimensional observation
- Vertical axis
- Horizontal axis
- Temporal axis

FSS (Lunvern)

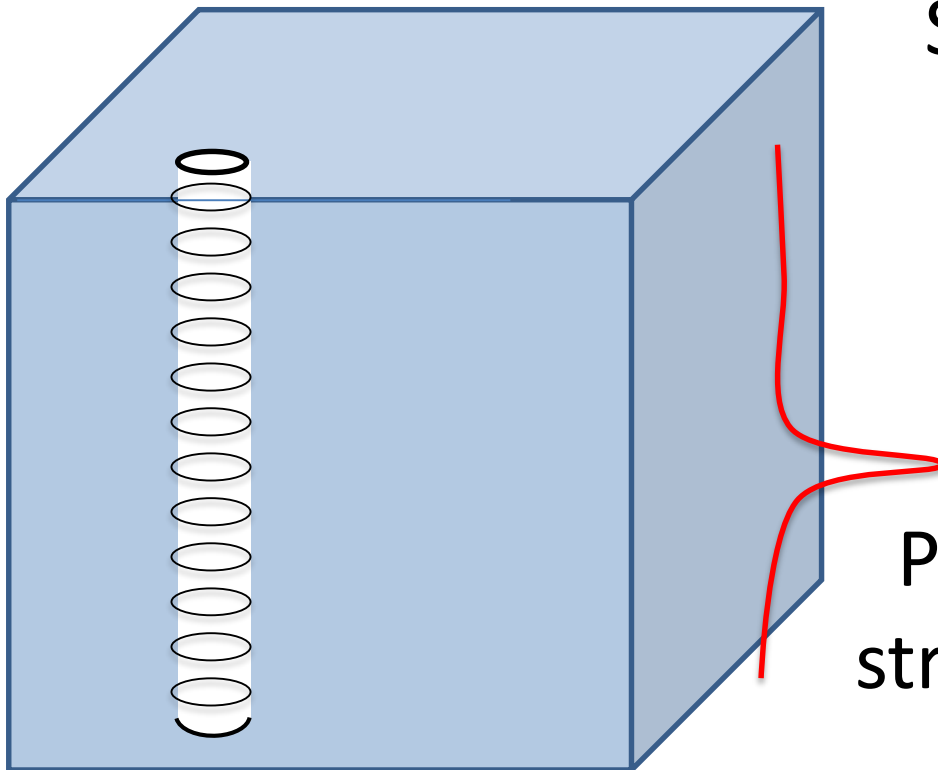


Phytoplankton concentration is heterogeneous 20-21.8m



Variation of concentration of microplankton in samples from 20 cm depth intervals in the pycnocline (vic. depth of the myctophid maximum) in March 1976 over the coastal shelf of the Southern California Bight (7603J MS1). *Prorocentrum*, tintinnids, and nauplii are larval anchovy food items.

Representativeness



Sampling from the water column is desired to ensure the representativeness.

Preservation of vertical structure is also required.

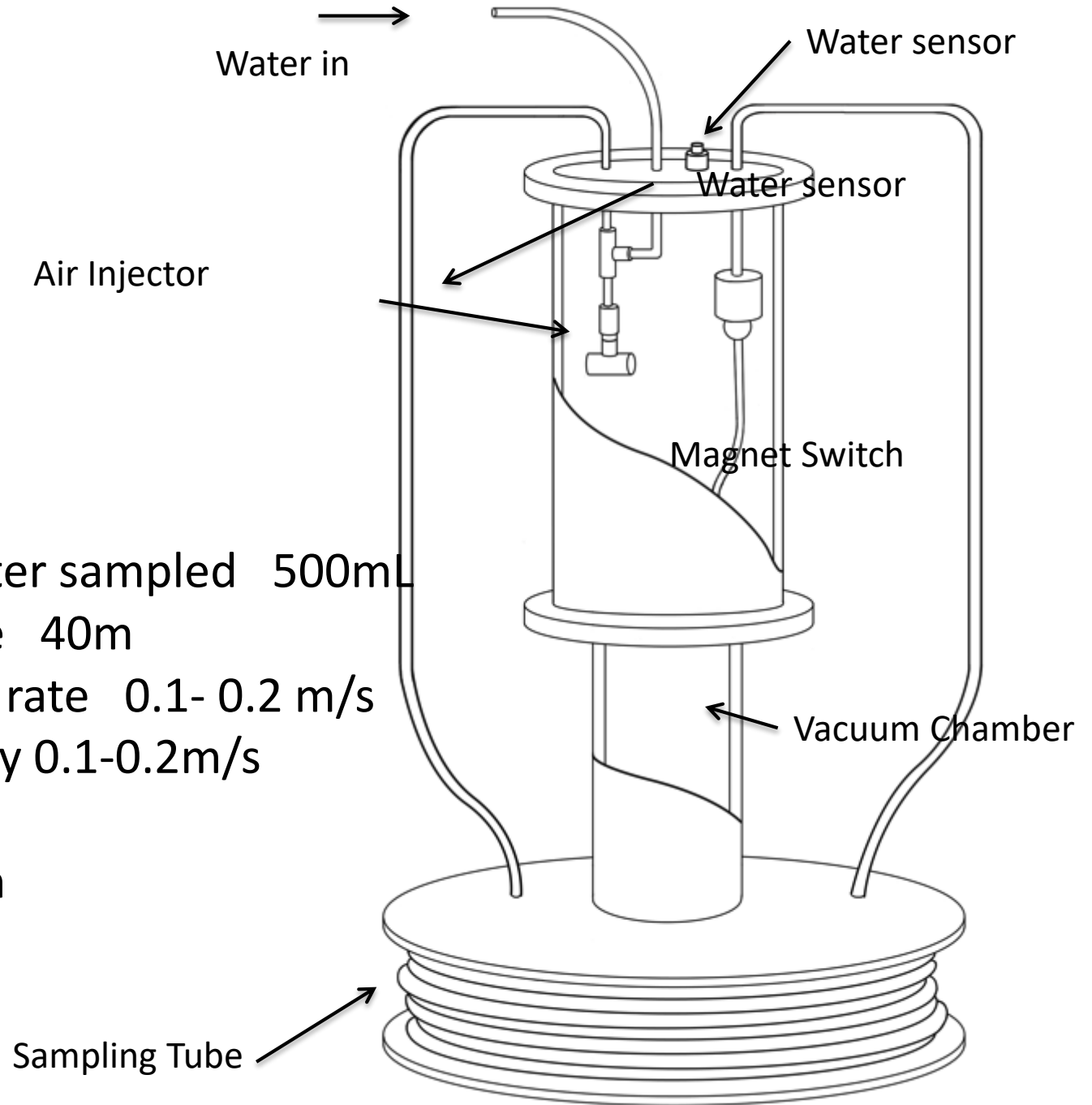
Lake

Desired specification of sampler

- Faster Sampling than phenomena
- Continuous sampling along vertical axis
- Higher spatial resolution than that of distribution of targeted matter
- Cost effective (can be deployed at many points)
- Winch (or A frame) is not required
- Less generation of Turbulence in Sampling

Similar to the core sampler for soil

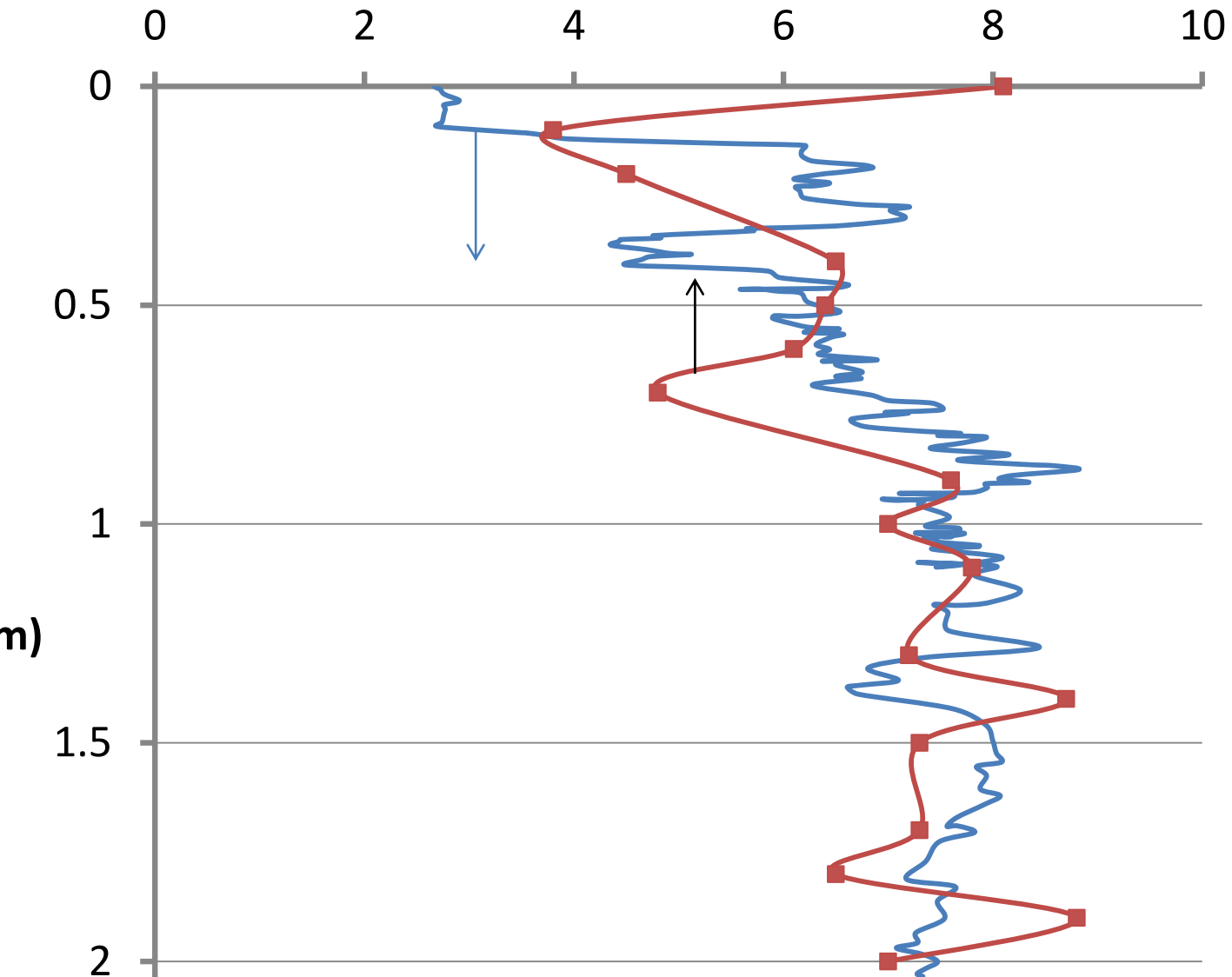




Volume of water sampled 500mL
Length of tube 40m
Sampling flow rate 0.1- 0.2 m/s
Sinking velocity 0.1-0.2m/s

Length 800m
Weight 12.3kg

Cell Density (X1000/cc)



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Problems to be solved

- Calibration of Depth

→ We plan to change the trigger from time base to depth base

- Stability of air bubbles

→ The volume of air will be optimized experimentally

Conclusions

- With newly developed Sampler, we can sample water with higher resolution than ever.
- Because sampling time is as short as typical vertical sensors such as CTD, we can deploy and retrieve sampler in 5 minutes. (for profiling 30m). Then horizontal resolution and temporal resolution of observation is also increased more than several times.

Application of this Sampler

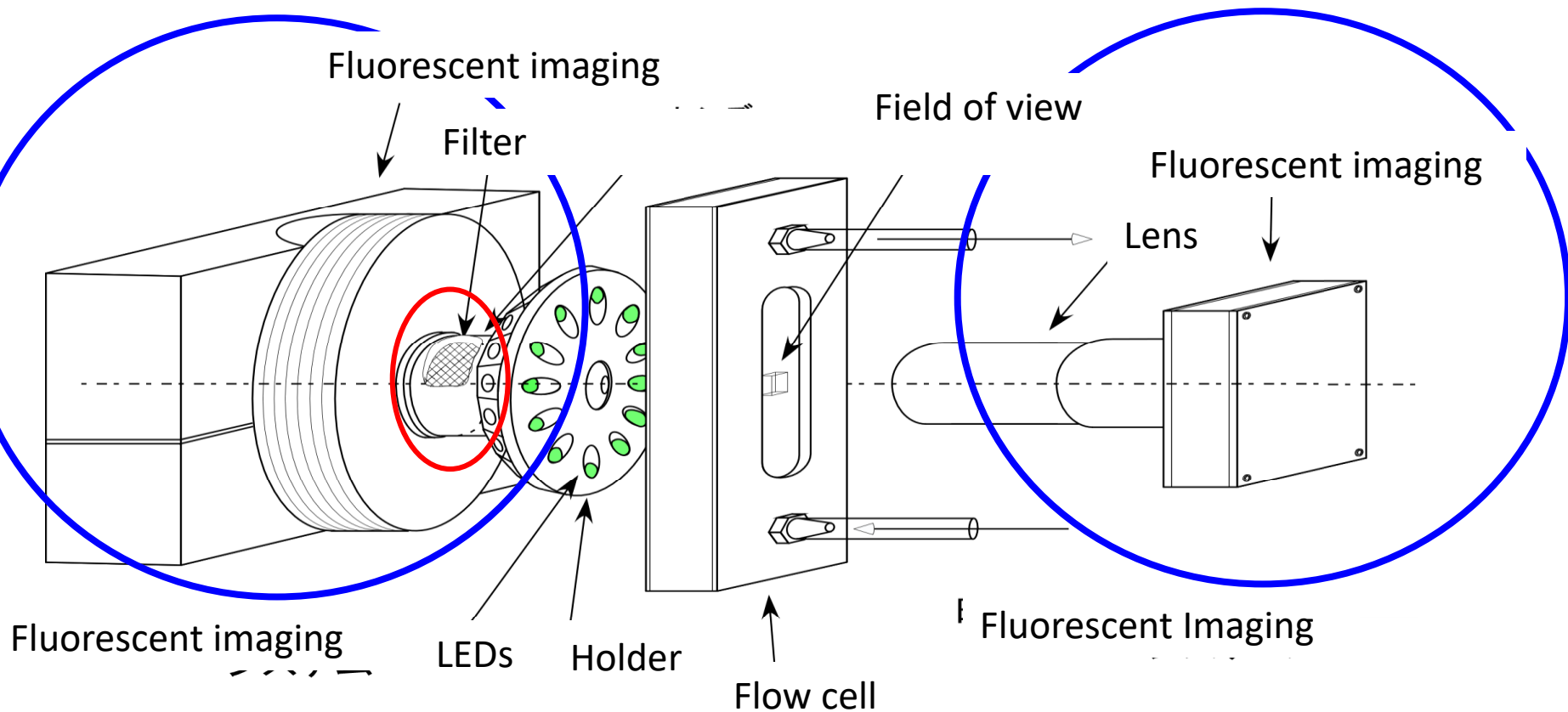
Environmental monitoring

Sediment transport

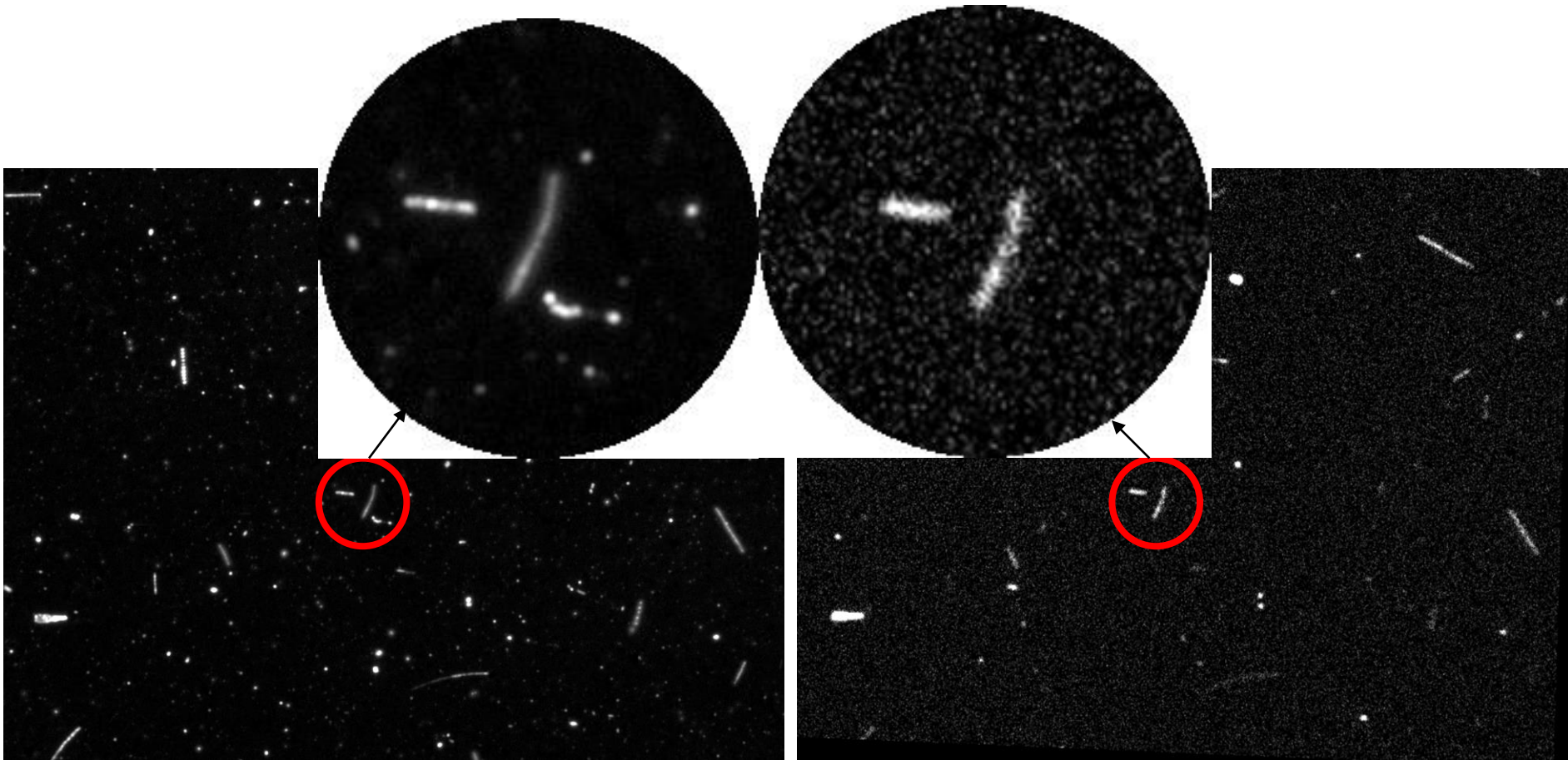
Biological response to hypoxia layer

Short time response of the ecosystem

Imaging of SPM with fluorescence and dark field



Proof of principle experiment



Dark field Image

Fluorescent image

Phytoplankton is distinguished from non-fluorescent particles