Using autonomous underwater seagliders for upper ocean biochemistry monitoring over an annual cycle in temperate latitudes of the North Atlantic Ocean

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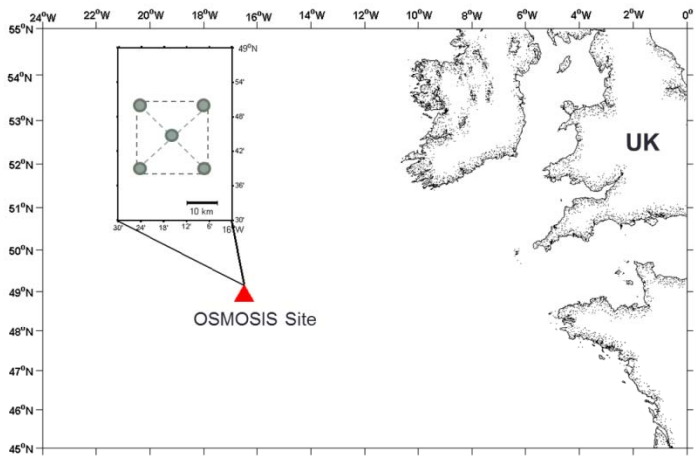
NATURAL ENVIRONMENT RESEARCH COUNCIL

UK ocean glider workshop 2013

Project overview

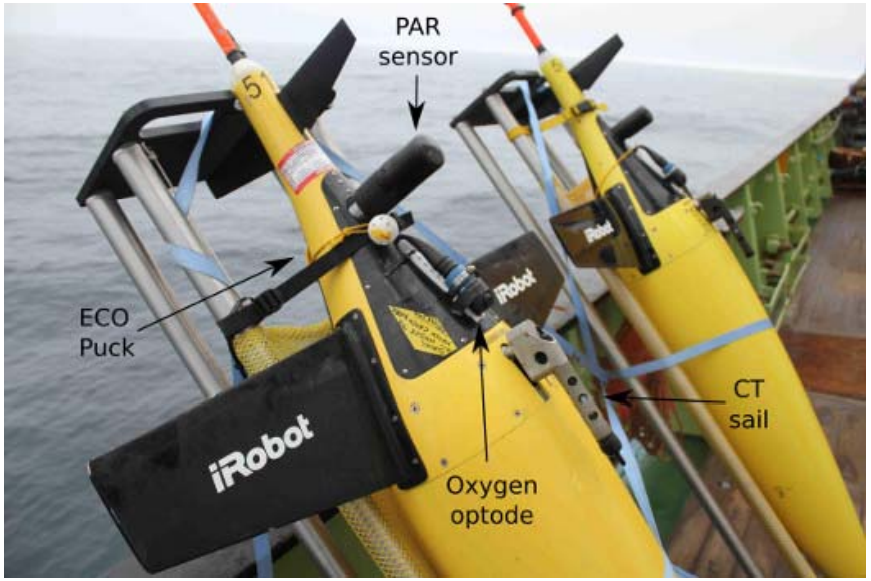
- OSMOSIS (Ocean Surface Mixing, Ocean Sub-mesoscale Interactions Study) project
- Two autonomous underwater Seagliders
- Deployed from September 2012 to September 2013
- Gliders turnover every 3-4 months
- Sampling area: 49 °N, 16.5 °W
- Size of the sampling area is 20 x 20 km^2



Biochemical data

- Chlorophyll a fluorescence
- Particulate Optical Backscatter
- Coloured Dissolved Organic Matter
- Photosynthetic Active Radiation (PAR)
- Oxygen (down to 1000 m)

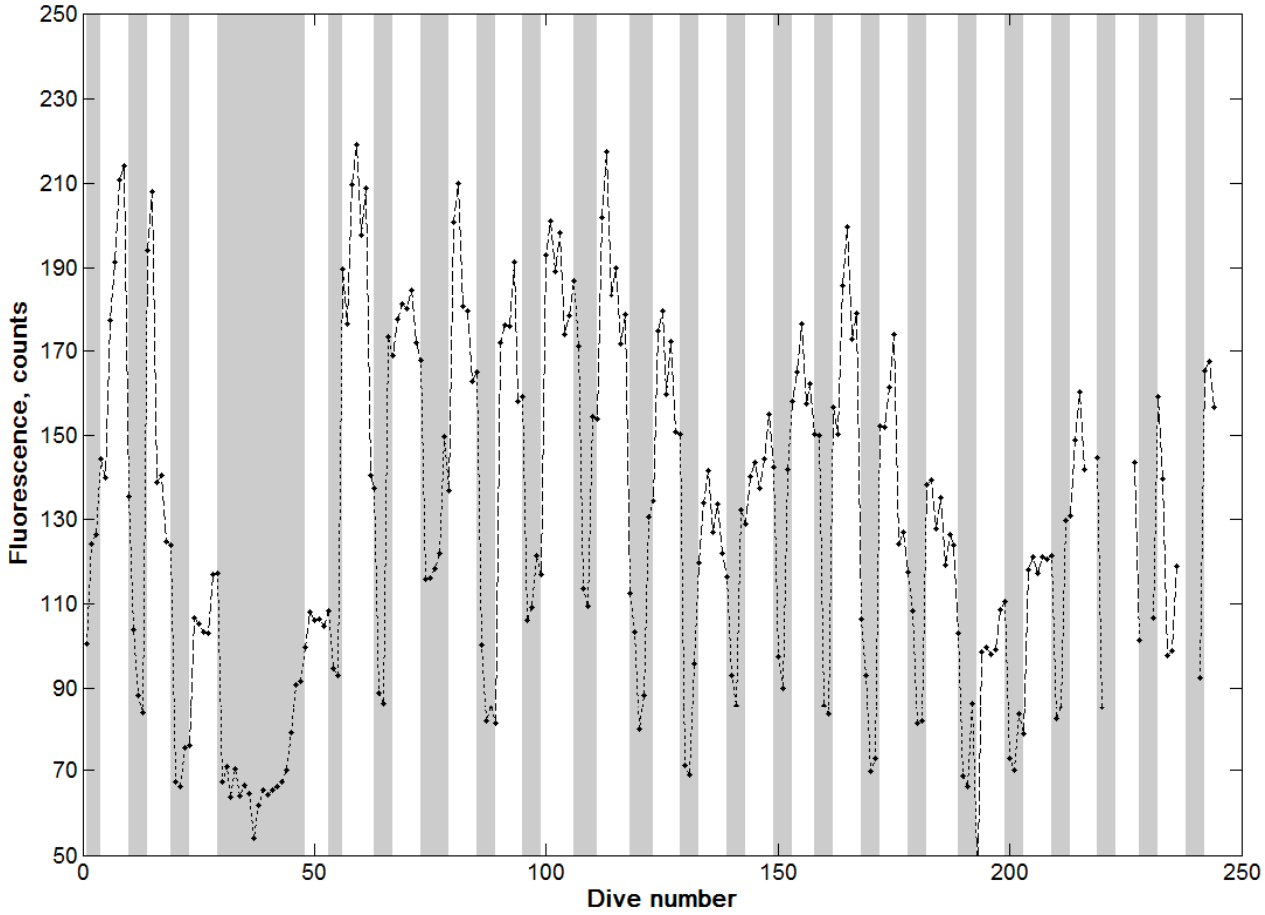
ECO PUCK (down to 100 – 500 m depth)



Key tasks for my PhD project

- Observe chlorophyll *a* annual cycle
- Influence of stratification/destratification events and light conditions on the chlorophyll vertical distribution
- Formation and erosion of the deep chlorophyll maximum (DCM)
- Test existing hypothesis for phytoplankton spring bloom initiation

Quenching effects



During daytime (6 am – 7 pm; grey stripes on the plot) significant decrease in surface fluorescence was observed down to 20 – 30 m due to quenching.

Non-Photochemical Quenching (NPQ)

Some daytime profiles could be corrected using the backscatter data

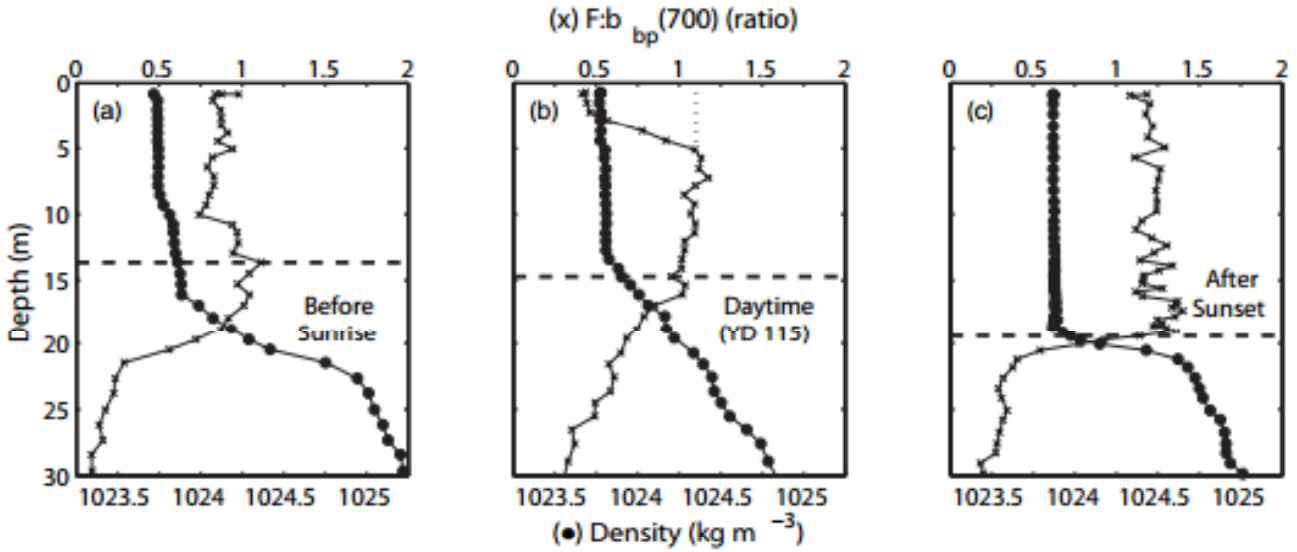
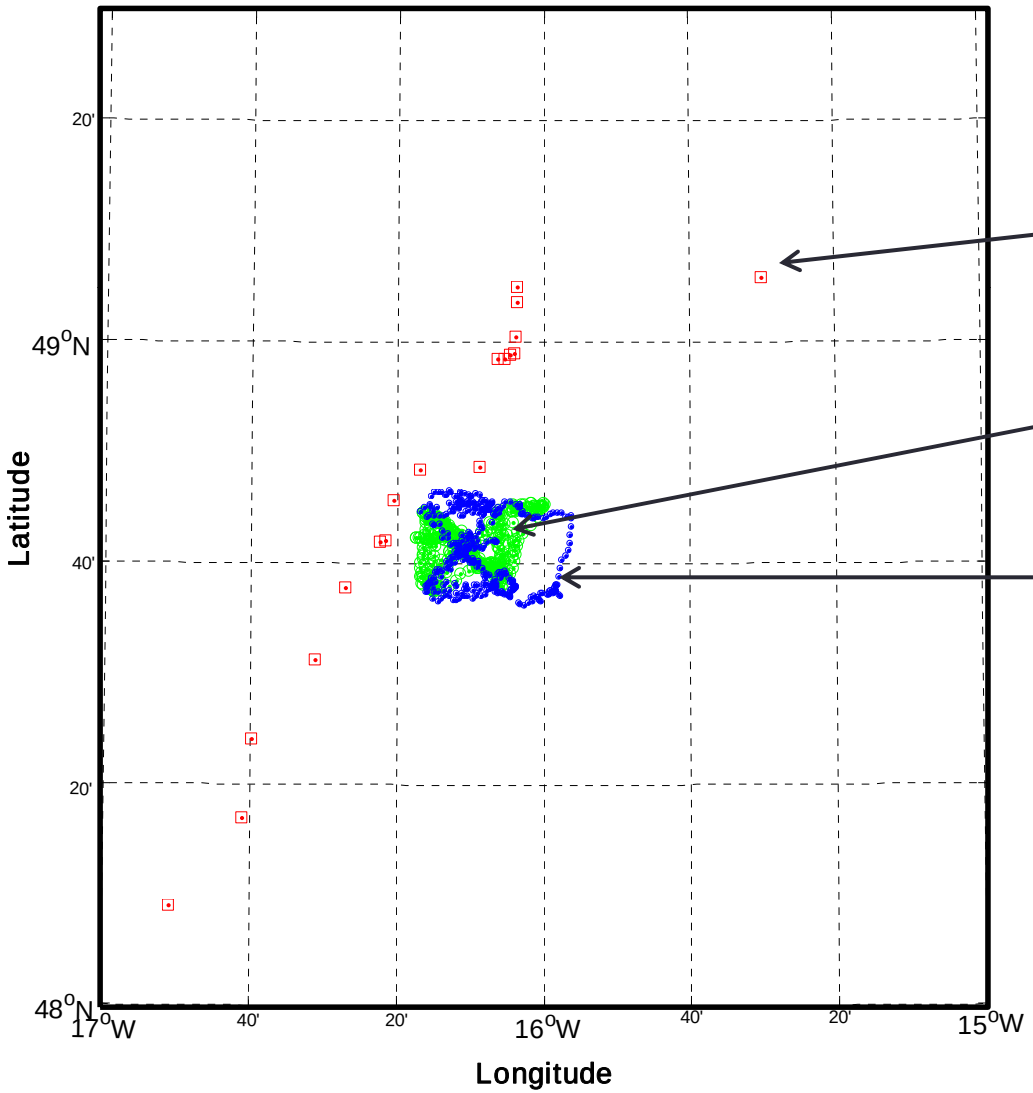


Fig. 3. Single profiles of fluoresence-to-backscattering ratios (F:b_{bp}(700); (x)) and density (filled circles) from YD 115 **(a)** before sunrise (local time 0448), **(b)** at mid-day (local noon), and **(c)** after sunset (local time 2210). The dotted line in panel (b) is the estimated value for F:b_{bp}(700) in the absence of quenching.

(from B. S. Sackmann et al., 2008)

Data calibration (work in progress…)



CTD stations (red squares)

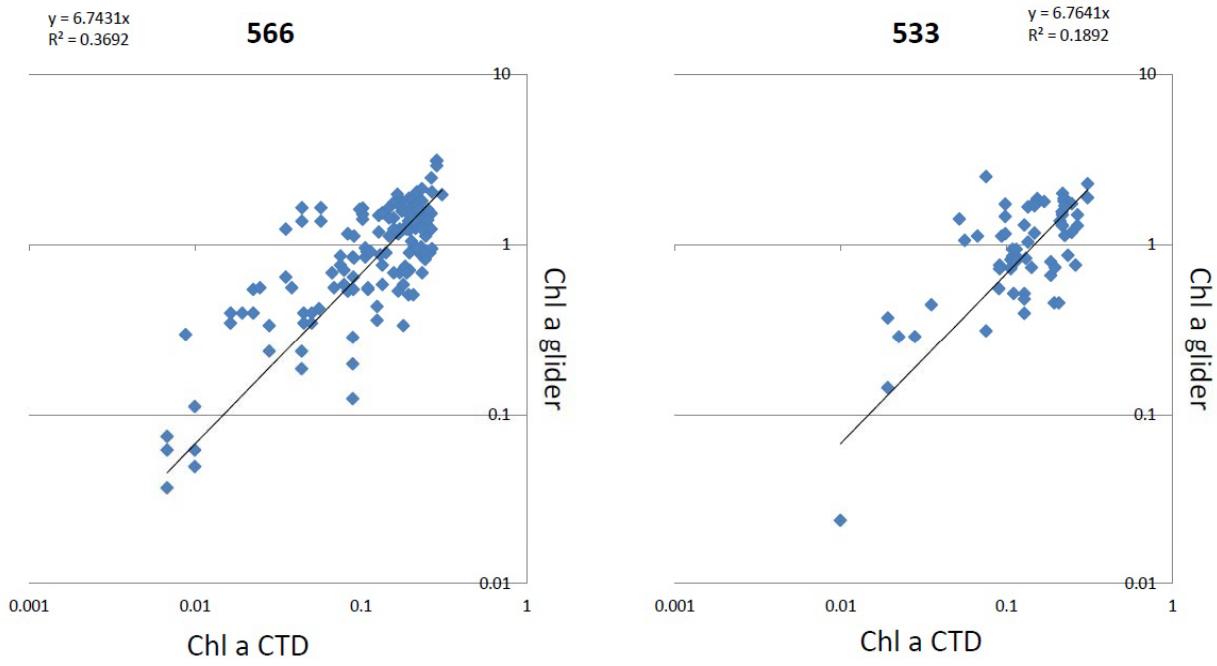
566 glider dives during D381 cruise (green dots)

533 glider dives during D381 cruise (blue dots)

19 CTD profiles from the cruise were used for the data calibration (Niskin bottles data, depth 5 – 100 m)

Data calibration (work in progress…)

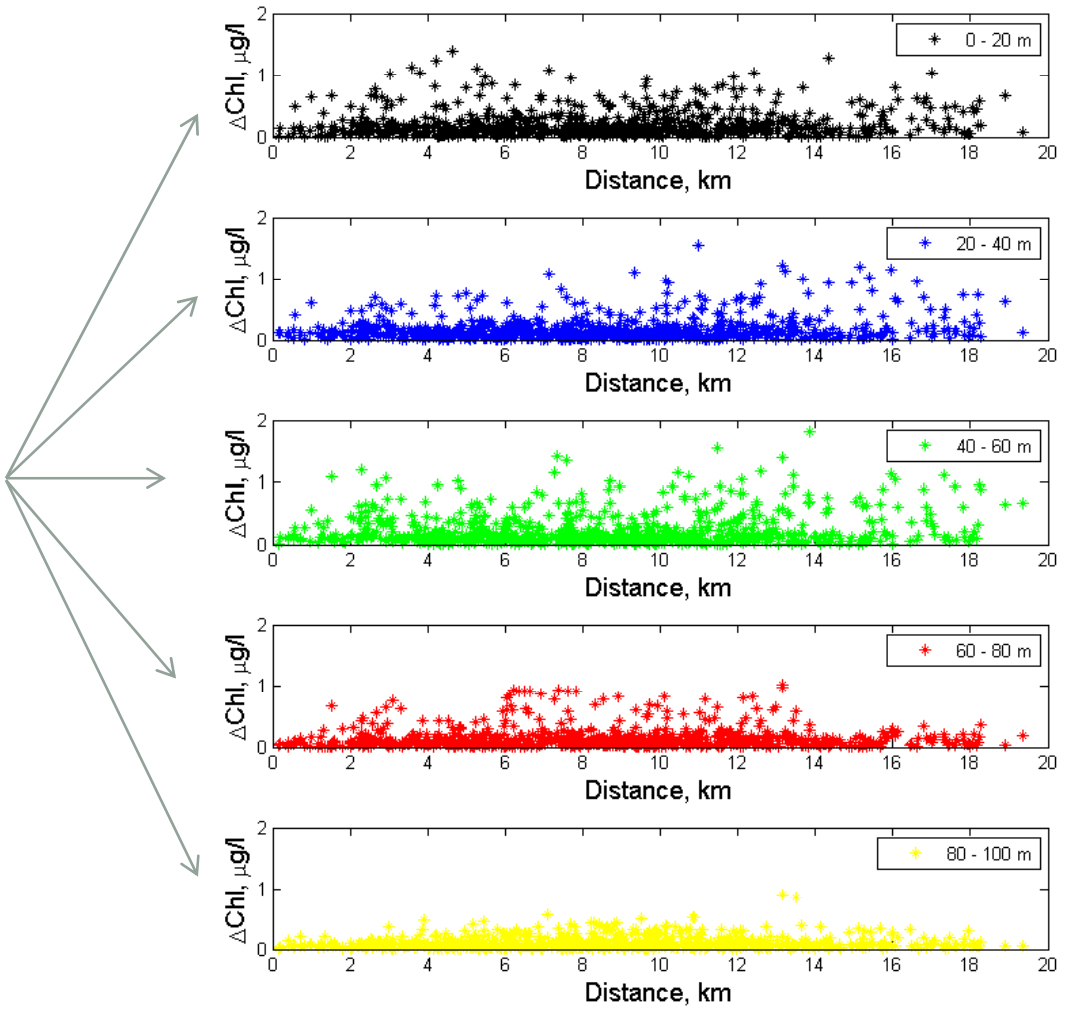
1. For each CTD cast all gliders dives that were done within +/- 12 hours were selected
2. Daytime (6 am – 19 pm) surface data (0 – 30 m) was excluded from the calibration due to quenching effects.
3. The trendline was set to intercept zero.



Excluded daytime profiles because of quenching

Can we use the data from the two gliders as a time-series?

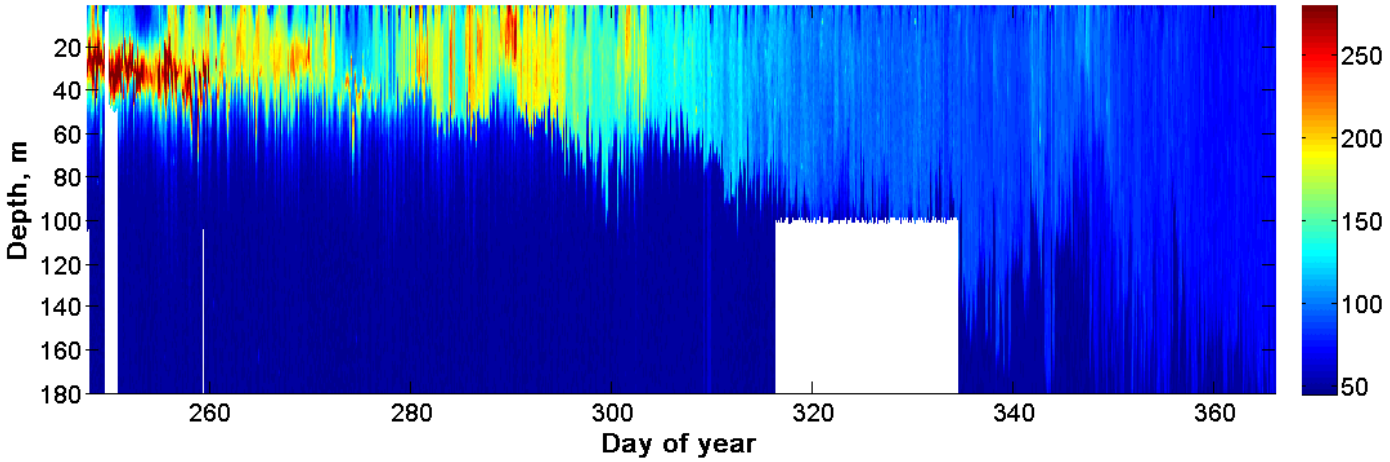
Difference between mean chlorophyll values from two gliders profiles (533 and 566) closest in time



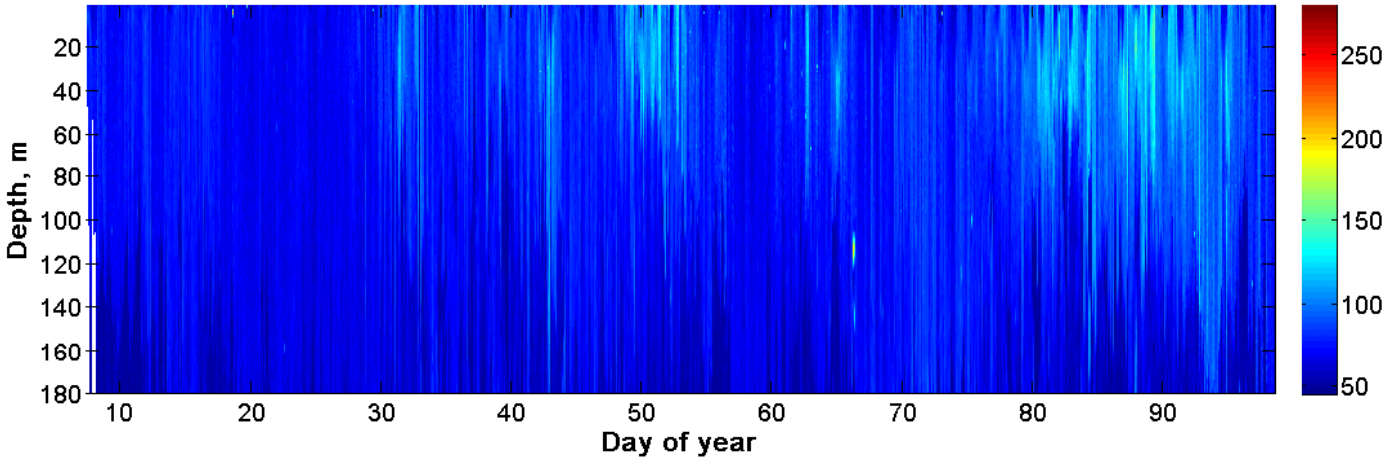
No trend in all bins

TS – analysis will be conducted for the more detailed investigation of the problem

Chlorophyll variability in the area



First deployment, autumn - winter 2012



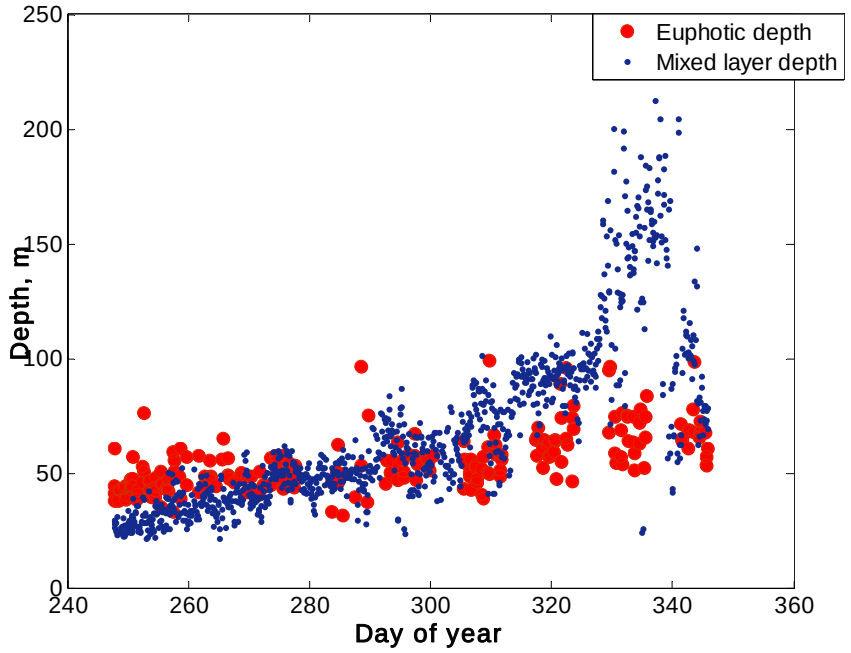
Fluorescence, counts

Second deployment, winter - spring 2013

High-resolution measurements over a long period of time

Biochemical data

- ✓ Simultaneous measurements of physical and biological properties
- ✓ Sampling key variables for the study of primary production (mixed layer depth, euphotic zone depth, chlorophyll concentration) during any time of the year
- ✓ Powerful complement to surface limited satellite remote sensing in the study of primary production



Conclusions

- Seagliders provide a comprehensive opportunity for the upper ocean ecosystem monitoring
- Spatial variability in chlorophyll a must be considered before using the gliders chlorophyll a data as a time-series
- Non-photochemical quenching significantly affects daytime profiles. Backscatter data could be used to correct the profiles
- Calibrating chlorophyll glider data using in-situ measurements appears to be quite challenging…

Applying calibration