INSTITUTE OF MARINE RESEARCH

Use of Argo data for monitoring and studying the ecosystem in the Norwegian Sea

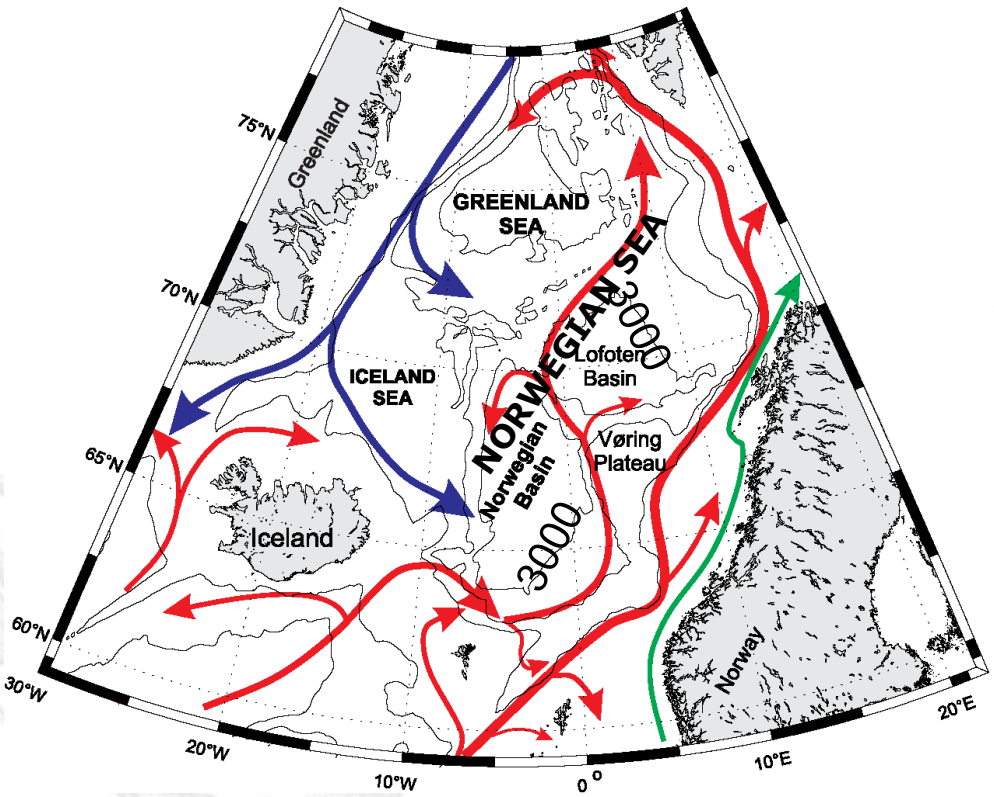
Kjell Arne Mork, Francisco Rey and Henrik Søiland

Institute of Marine Research, Norway

Outline

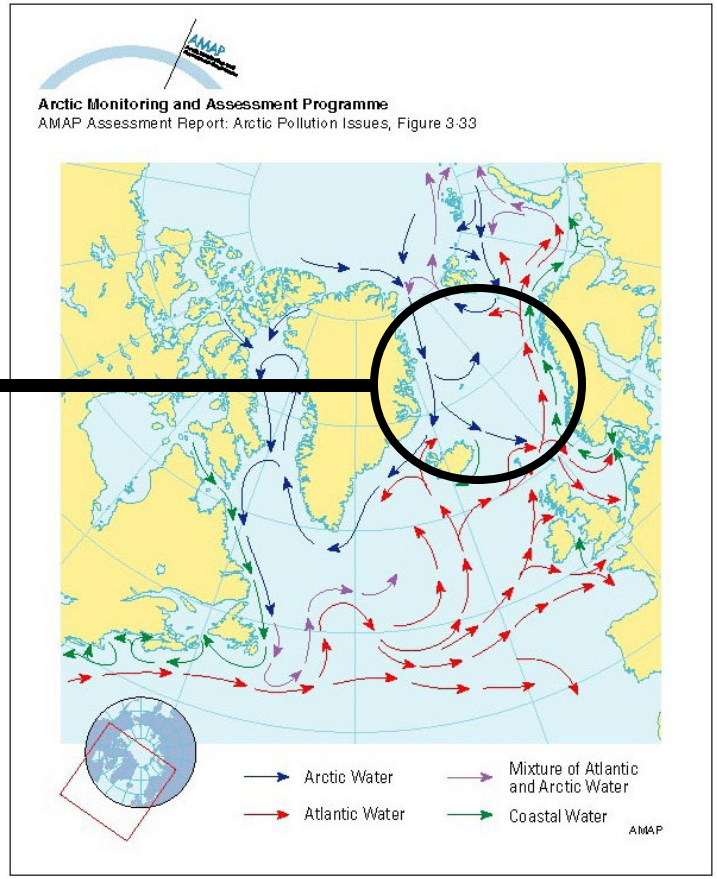
- The ecosystem in the Norwegian Sea and motivation
- Two Argo floats with extra sensors; Oxygen and Chlorophyll (Fluoressence)
- Water column stabilization, mixed layer depth and Svedrup's critical depth

Surface circulation in the Nordic Seas (Greenland, Norwegian and Iceland Sea)



Atlantic water Coastal water

Arctic water



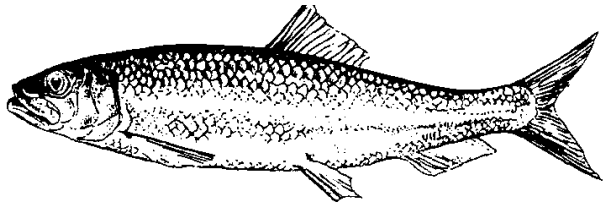
Some key features of the Norwegian Sea ecosystem

- High latitude and strong seasonality
- Effective conversion of primary (phytoplankton) into secondary production (zooplankton)
- Feeding migrations permit large pelagic fish stocks

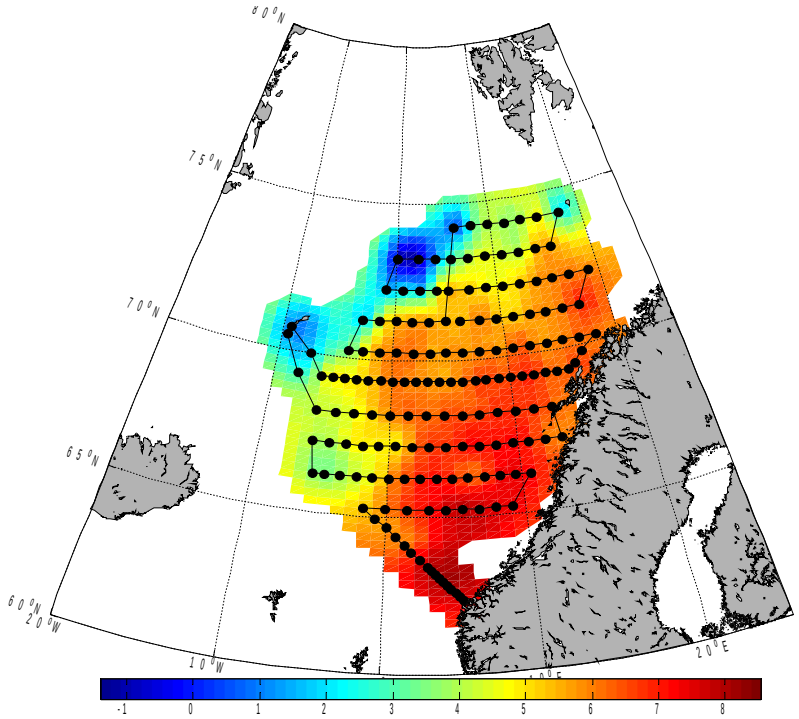
Potentially the largest herring stock in the world

- Spawning stock biomass about 12 mill tonnes

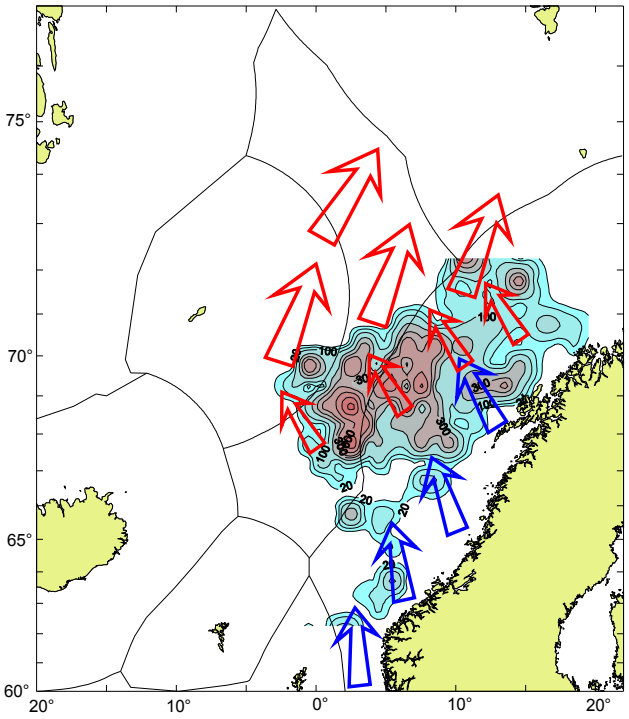
Herring is a major consumer of zooplankton in the Norwegian Sea



Pelagic cruises during May

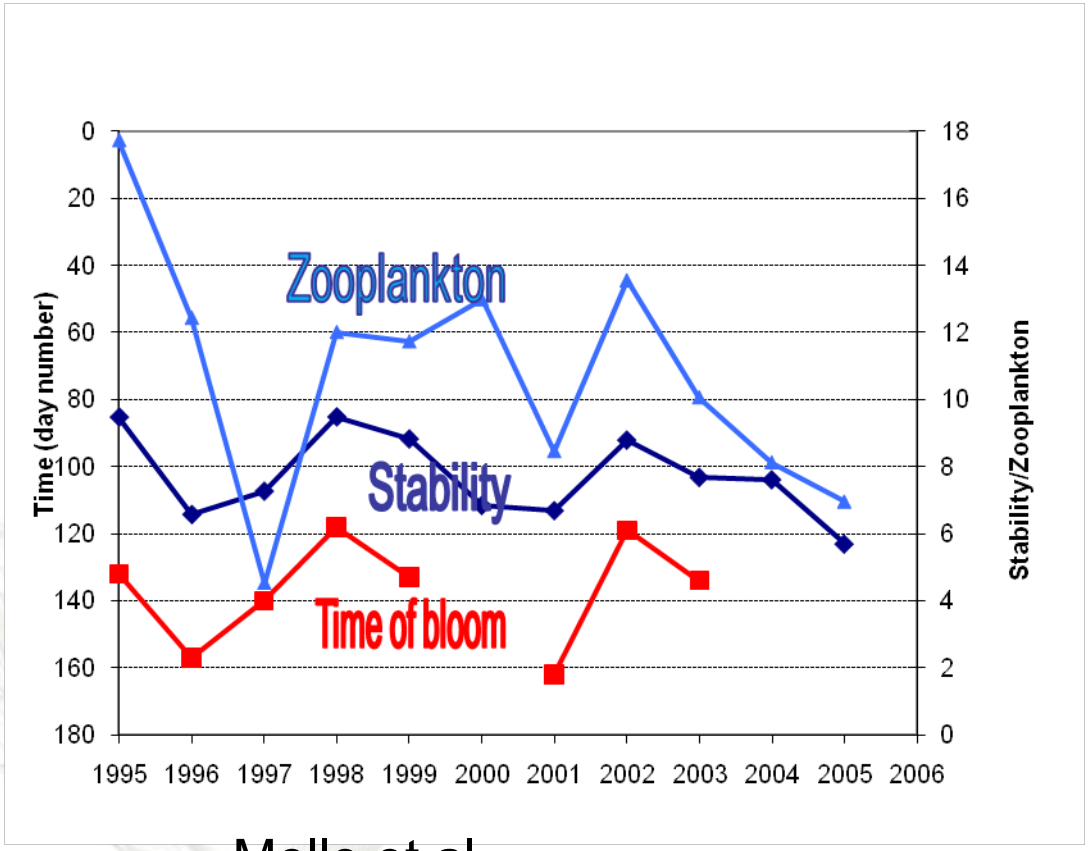


CTD-stations taken during a pelagic cruise in 2003 from end of April to start of June. The temperature at 100 m depth is also shown.

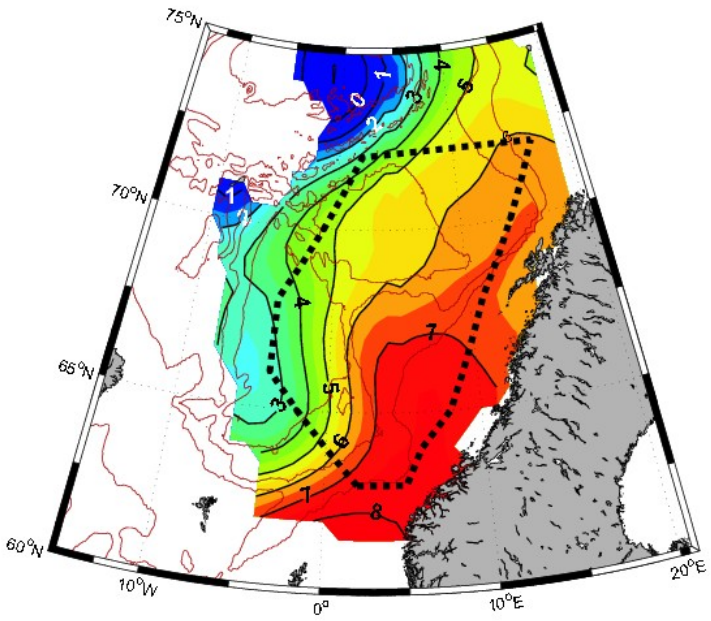


Herring distribution in May 2003 and migration during April (blue vectors) and June (red vectors)

Strong link between herring condition (~weight/length^3), i.e. feeding success, and zooplankton biomass (Melle et al., 2009)

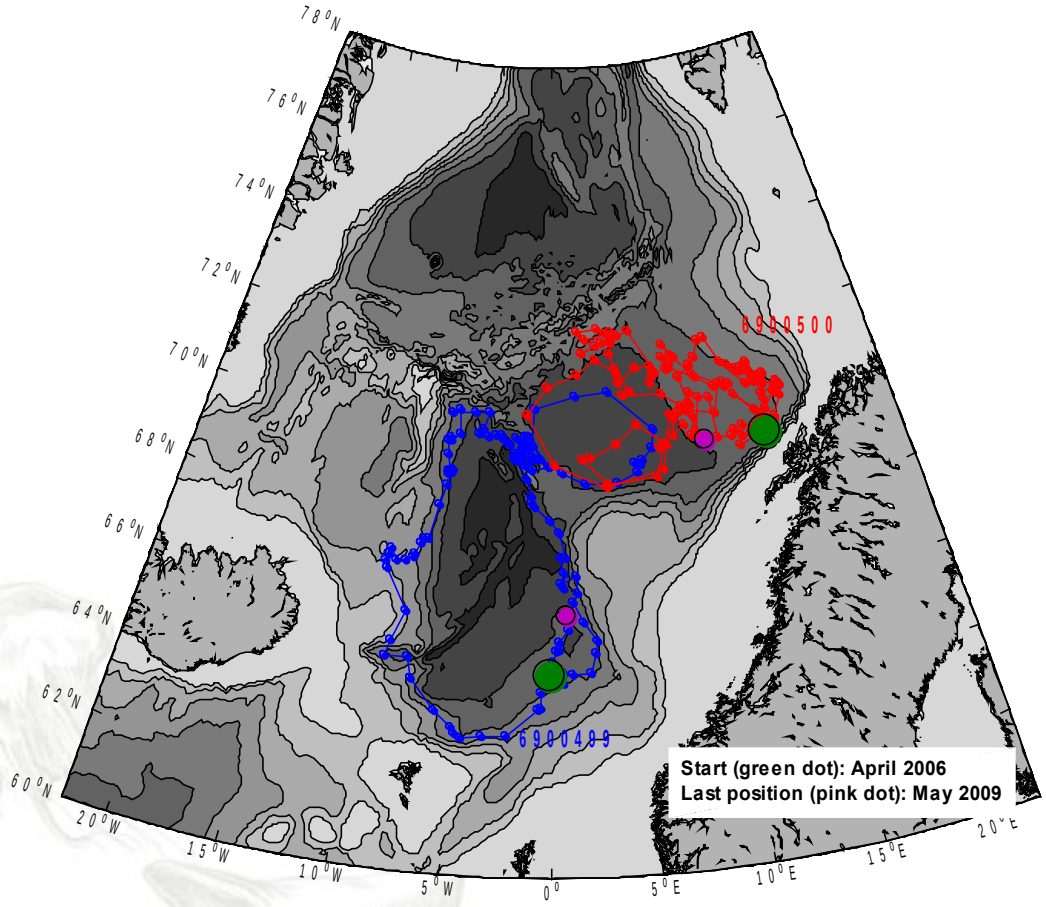


Melle et al. (2009)



Area for averaged stability

Two Argo floats with extra sensors



From 2006 two Argo floats also equipped with oxygen and chlorophyll (fluoressence) sensors. Parking depth:1200 m

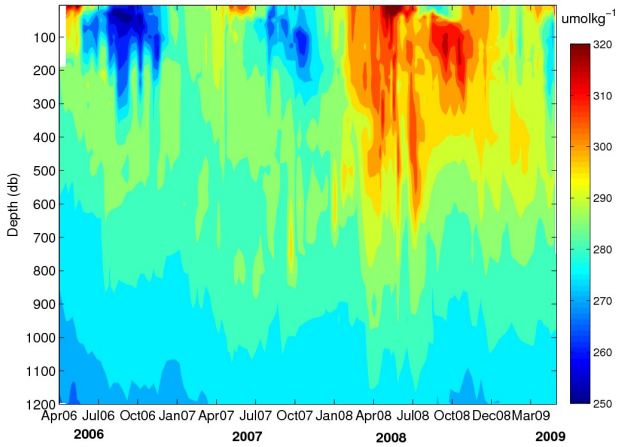
- 5 days cycle during April-May
- Chlorophyll measurements only in the upper 300 m and during March-October to save energy

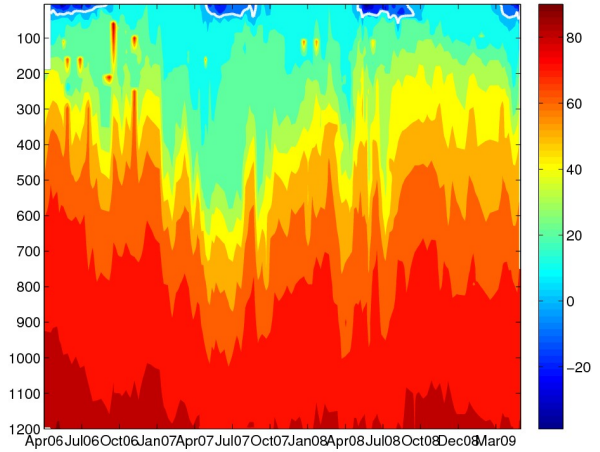
Oxygen and AOU (umol/kg)

Oxygen

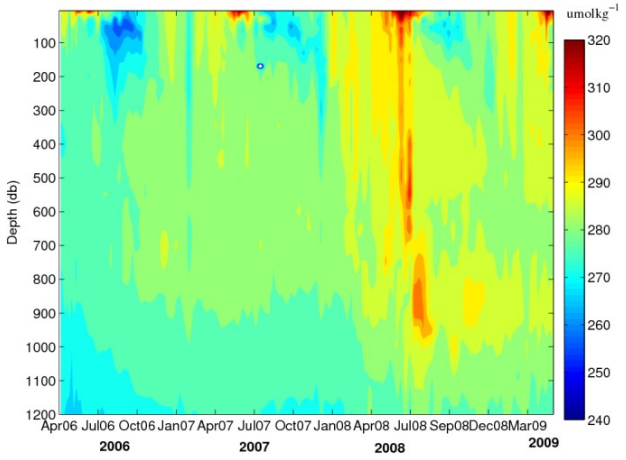
AOU

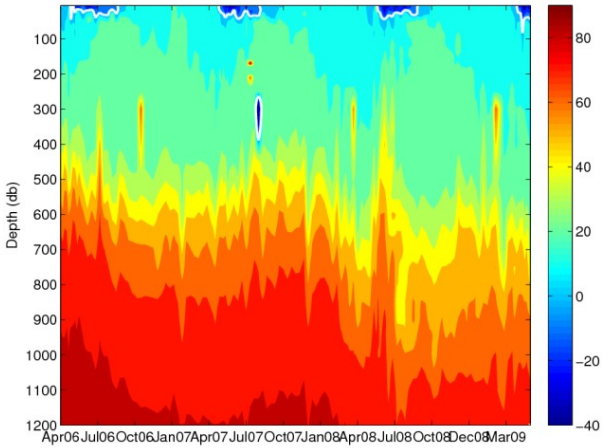
6900499





6900500





Apparent oxygen utilisation (AOU) is the difference between the measured dissolved oxygen concentration and its equilibrium saturation concentration. AOU<0 indicates oxygen production.

Key factors for plankton productivity

- Mixed layer depth (MLD)
- Sverdrup's Critical Depth (Dcr)

The phytoplankton production decrease with depth corresponding to the decrease of light intensity

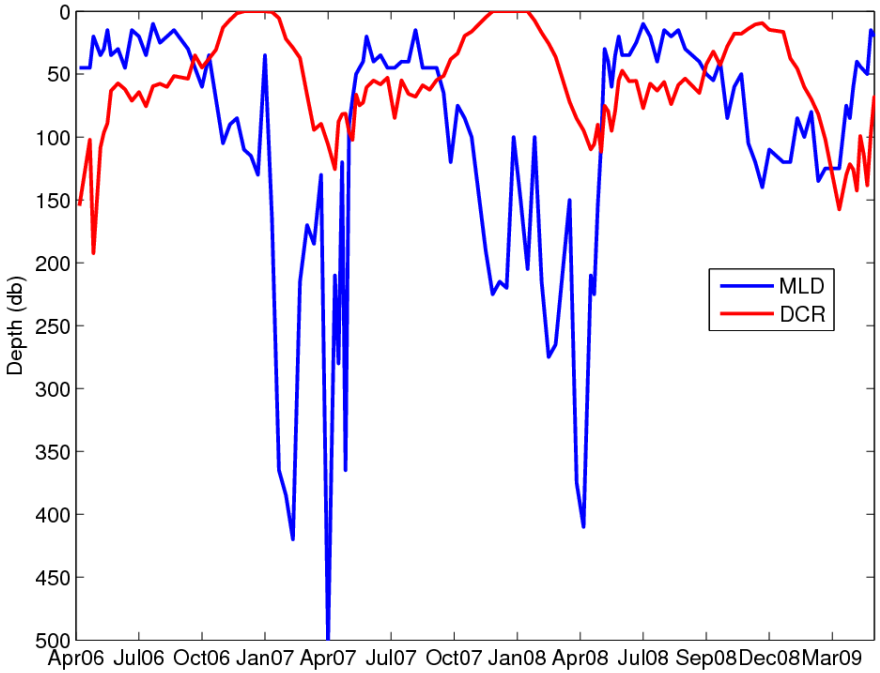
Assume that the organisms are evenly distributed in the mixed layer

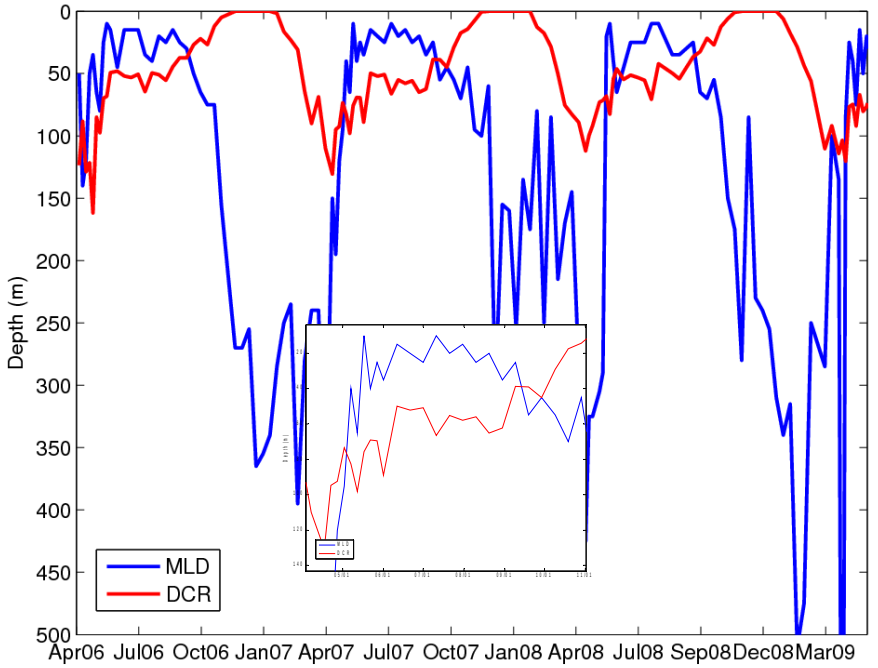
Net production/phytoplankton bloom kan only occur if the mixed layer depth is less than a critical value (Dcr)

Dcr: function of light and clarity of the water

MLD and Critical Depth (Dcr)

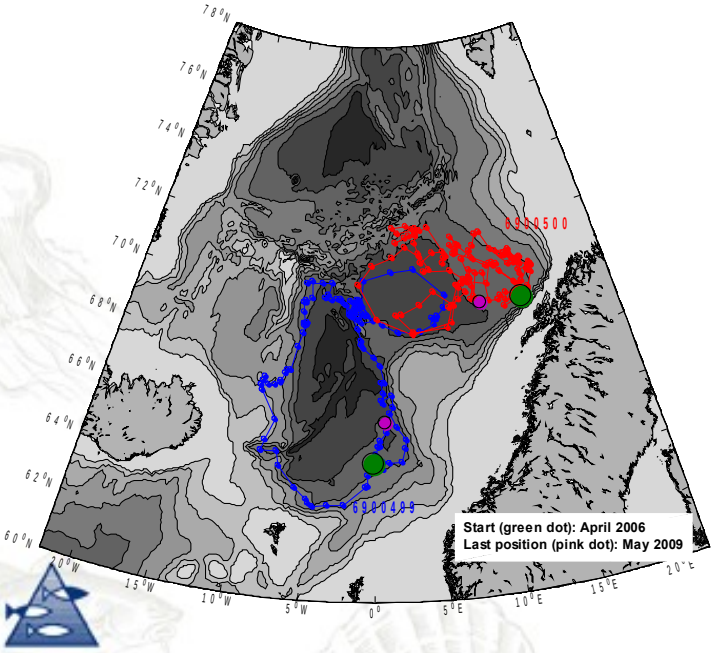
6900499 and 6900500

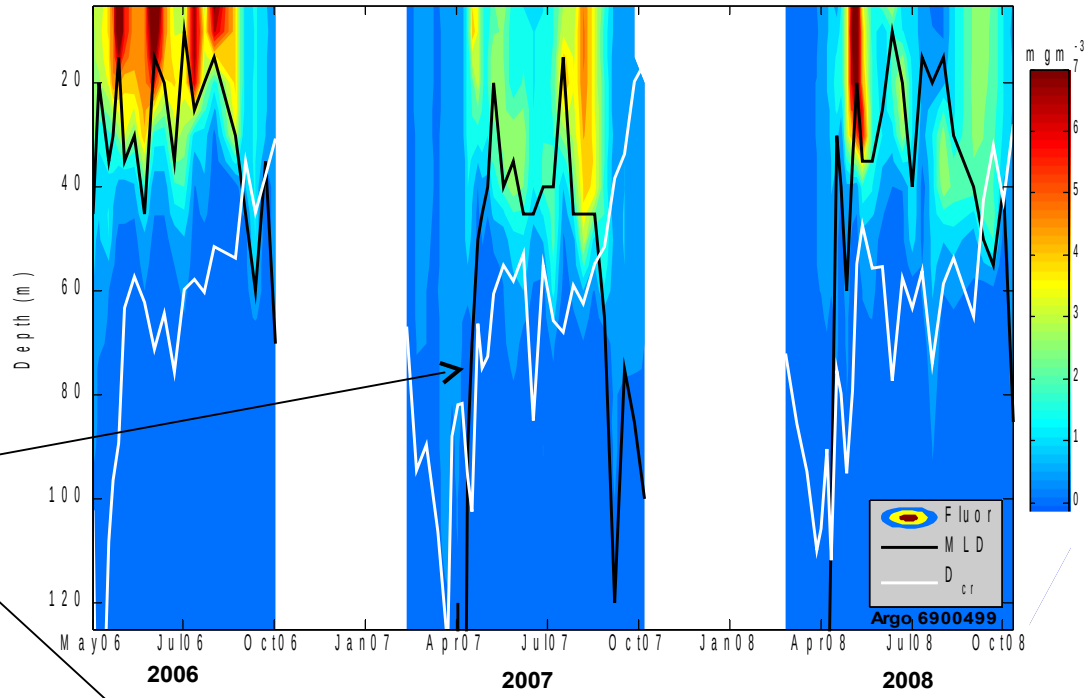


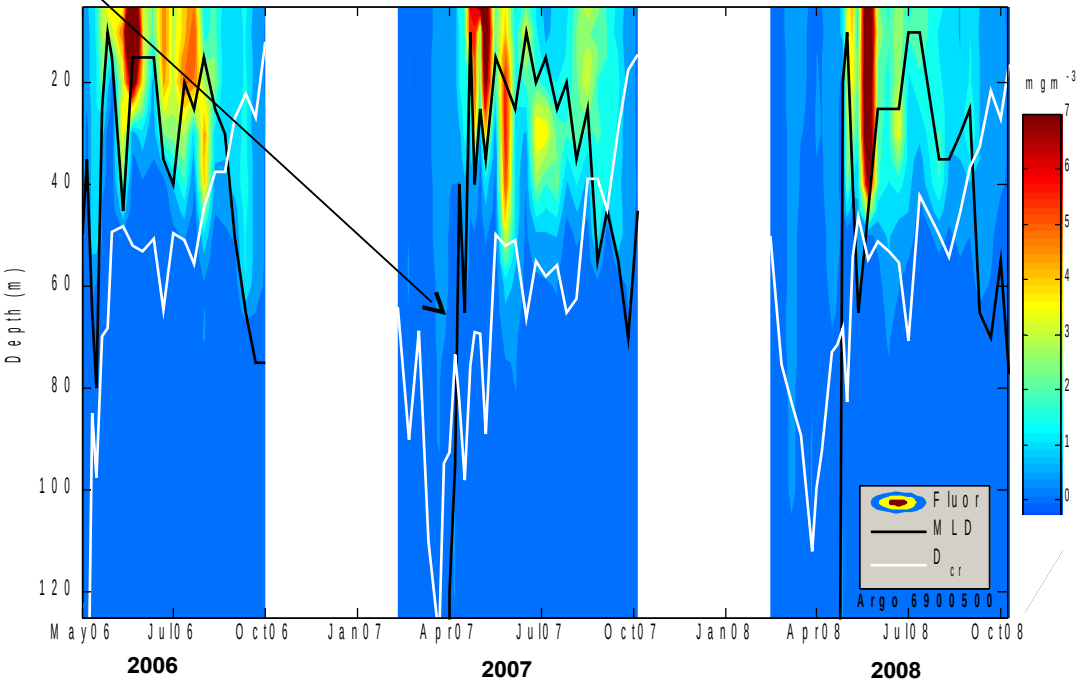


Chlorophyll and MLD, Dcr

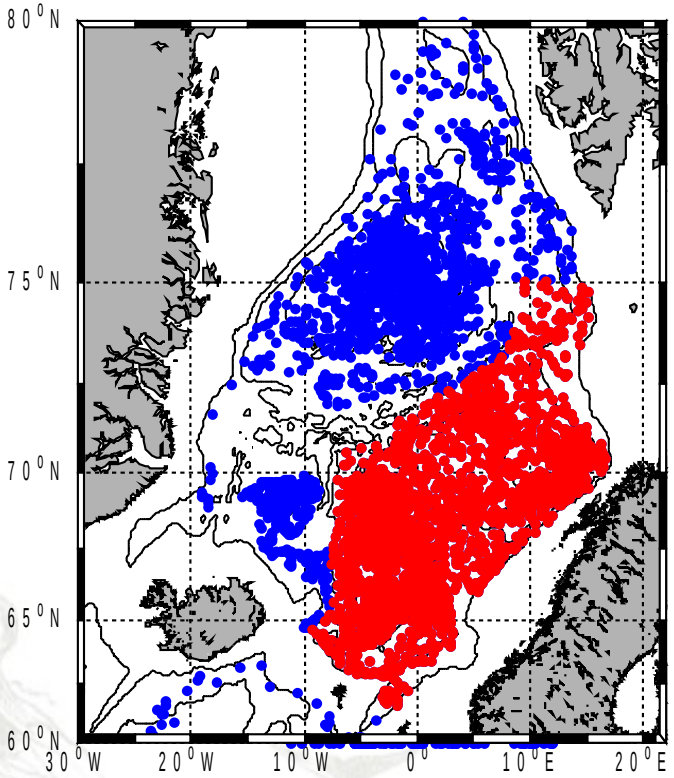
Phytoplankton bloom starts approximately when MLD<Dcr



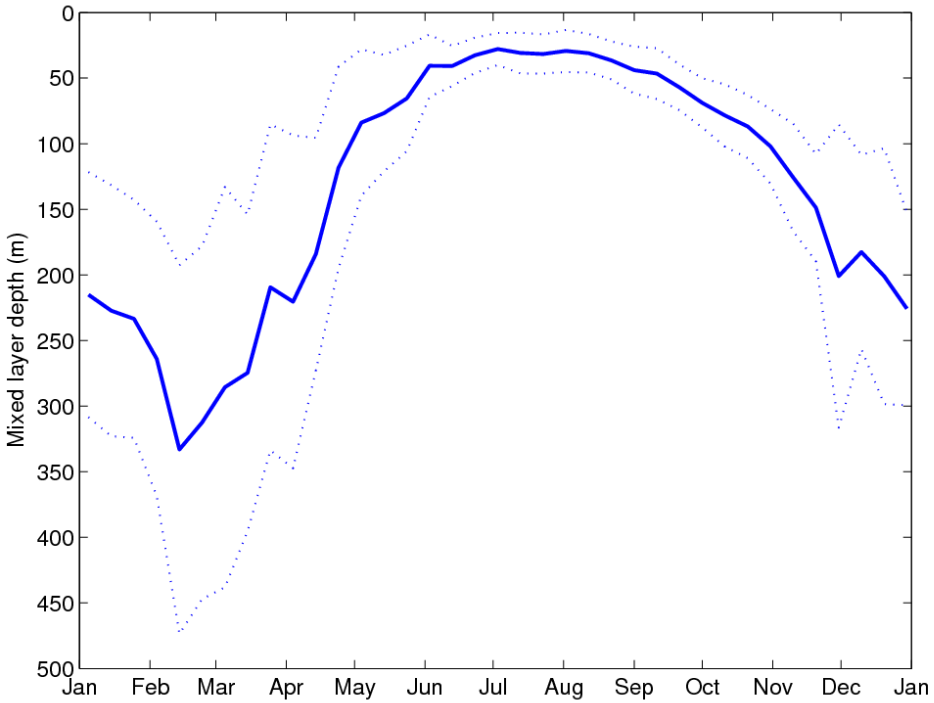




MLD when using all Argo floats

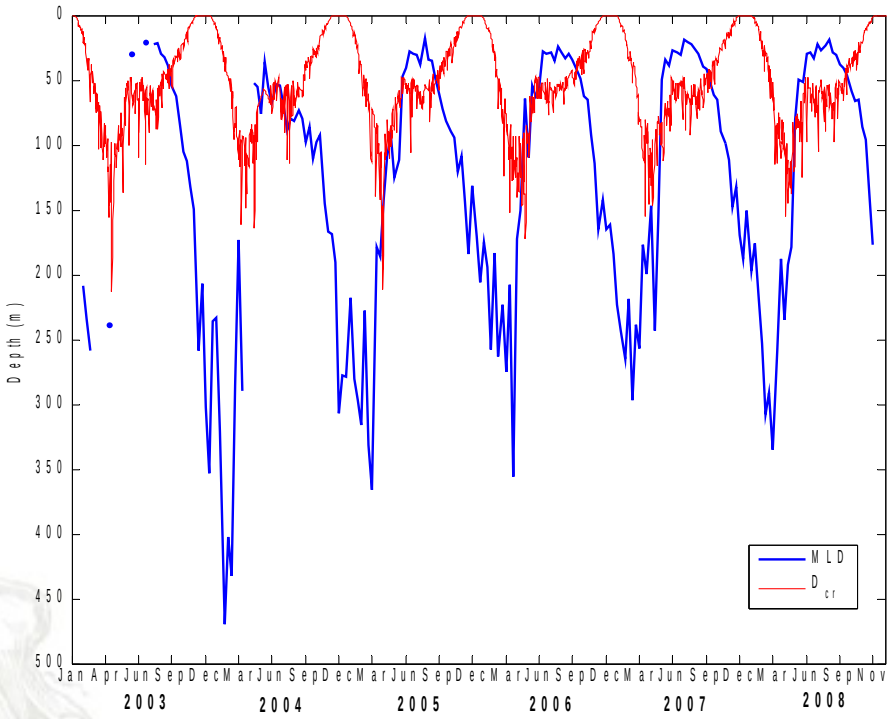


More than 3000 stations in the Norwegian Sea (red dots) during 2002-2008.

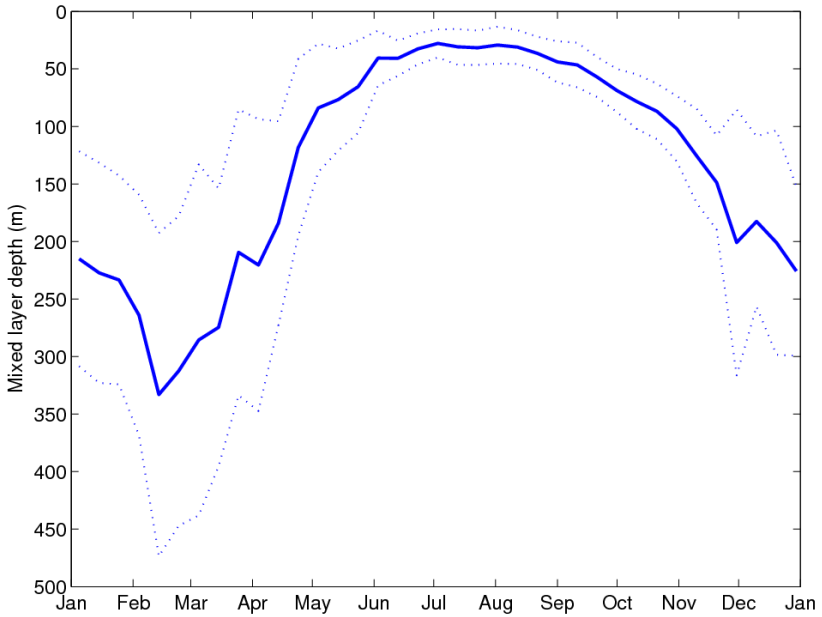


Mixed layer depth during the year (10 days window) with standard deviation

MLD and Dcr when using all Argo floats

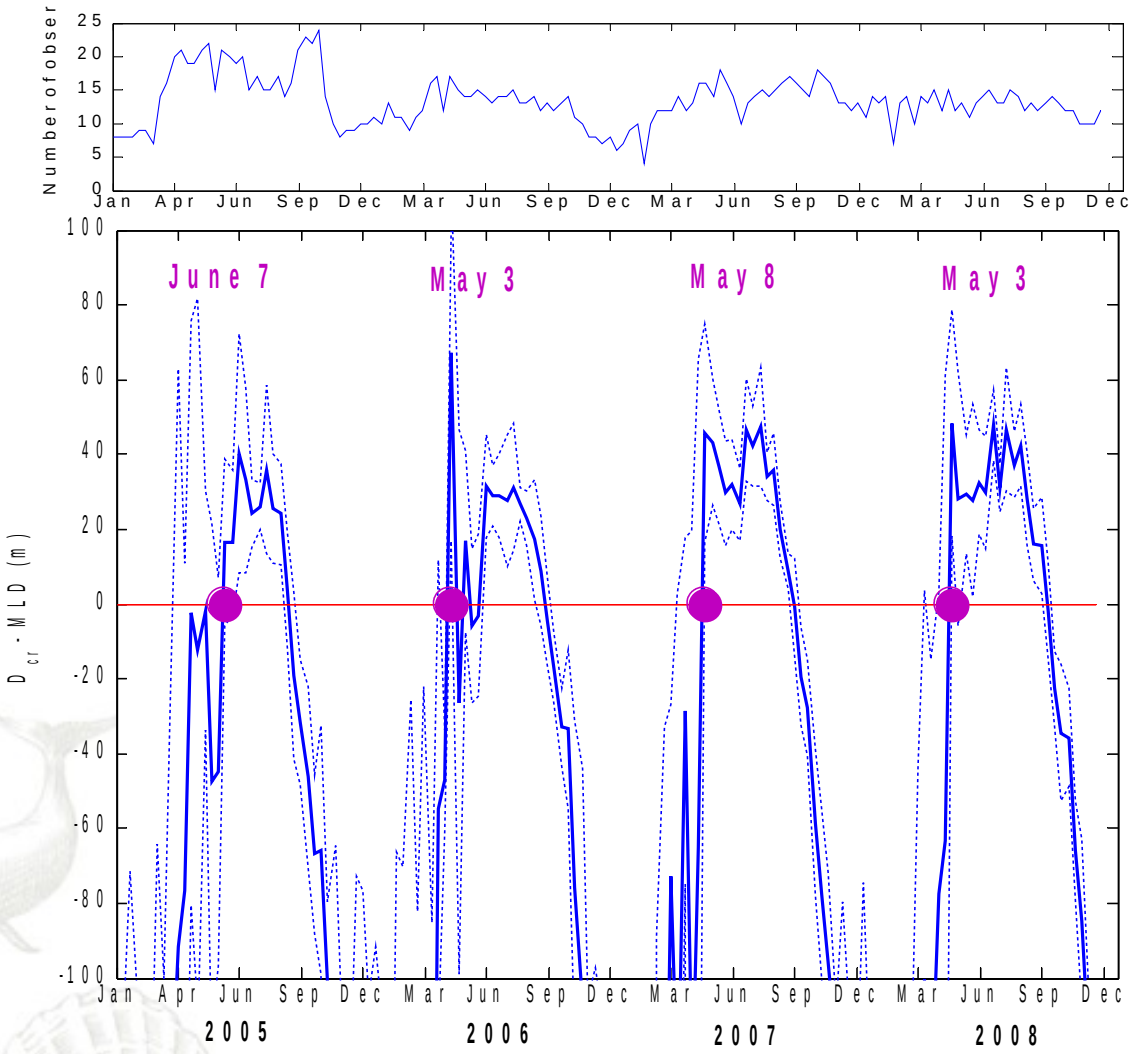


Mixed layer depth and Sverdrup's critical depth (Dcr)

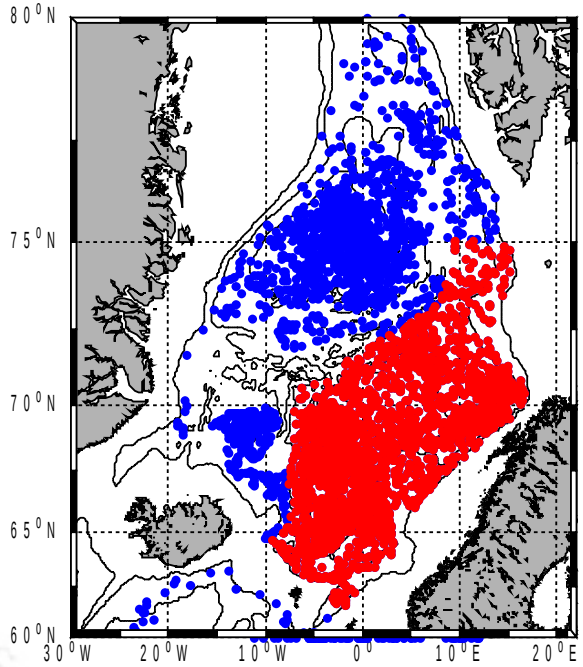


Mixed layer depth during the year (10 days window) with standard deviation

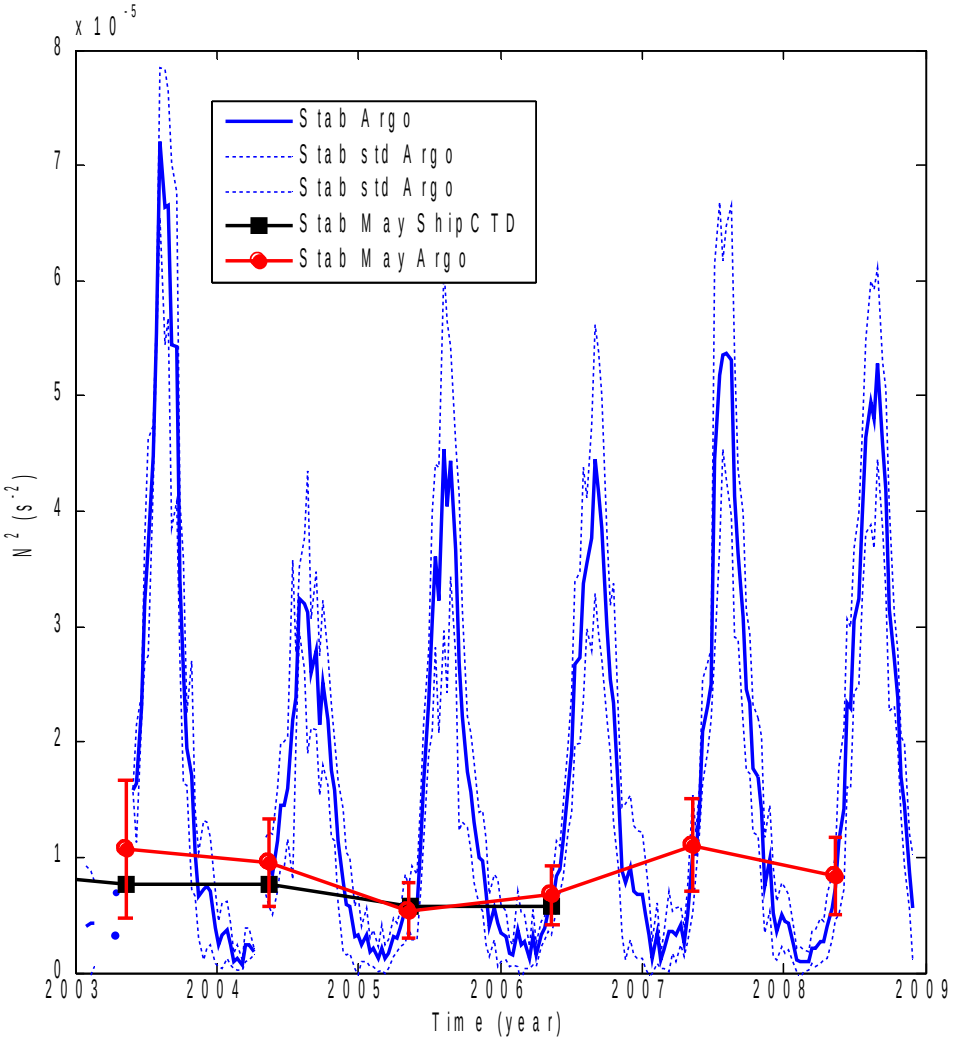
Timing of spring bloom in the Norwegian Sea using all Argo data (MLD) and Critical Depth



Stability/N² (0-200 m) from all Argo floats in the Norwegian Sea



More than 3000 stations in the Norwegian Sea (red dots) during 2002-2008.



Conclusion

Large potential in ecosystem studies with extra sensors (O, Fluor)

Also, when using only T,S-data

Next:

Update time series and do comparison also with herring time series (e.g. condition)

d/dt (oxygen/AOU): primary production