The influence of mesoscale activity on the primary production in the Norwegian Sea

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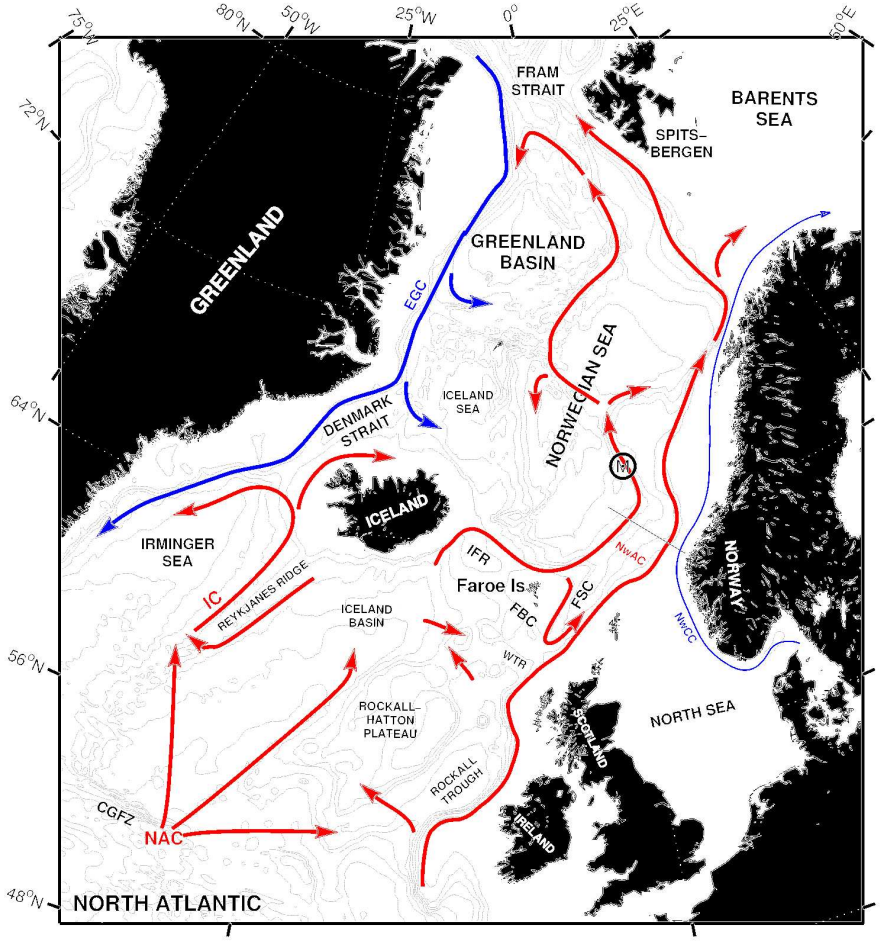
Outline

- Objective
- The current system in the Norwegian Sea
- Ecosystem in the Norwegian Sea
- Physical and biological models used in the experiment
- Preliminary results
- Future work

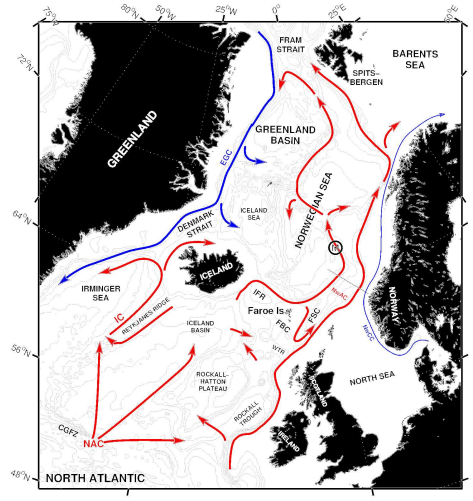
Current system in the Norwegian Sea



Furevik and Nilsen 2005,The Nordic Seas: An Integrated Perspective

Objective

Objective: Influence of the front dynamics on the primary production



Furevik and Nilsen 2005,The Nordic Seas: An Integrated Perspective

Ecosystem in the Norwegian Sea

Three dominating plankton groups:

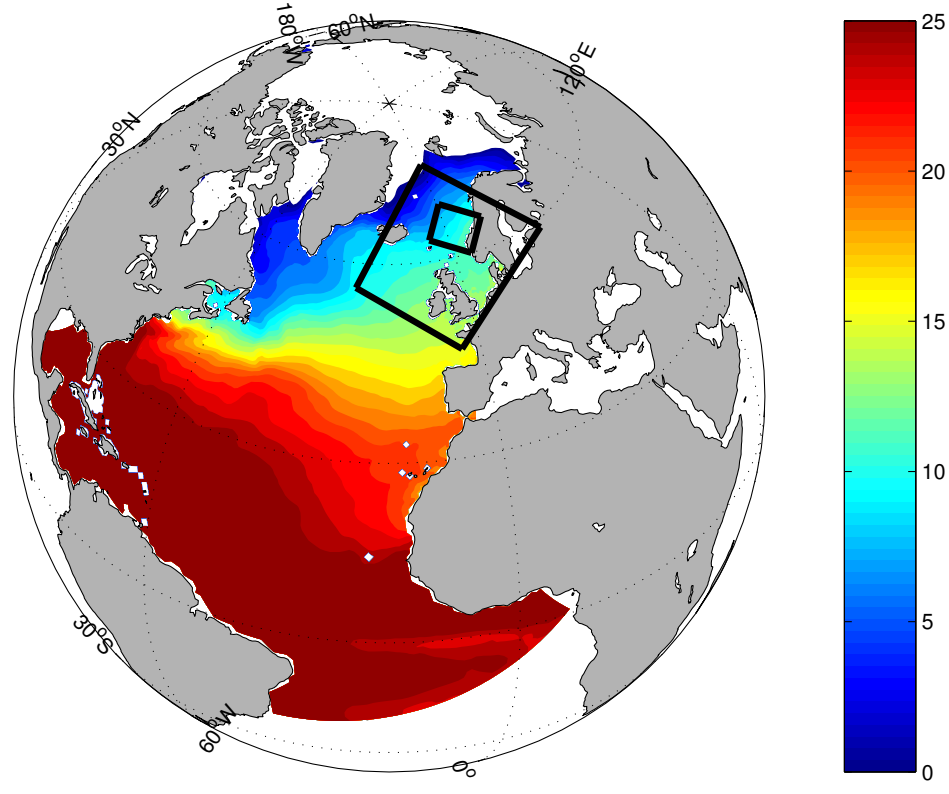
- Diatoms
- Flagellates (Prymnesiophytes)
- Dinoflagellates

The bloom is set off by:

- Shallowing of the pycnocline
  - Freshening of coastal water due to ice melting and river runoff
  - Windconditions

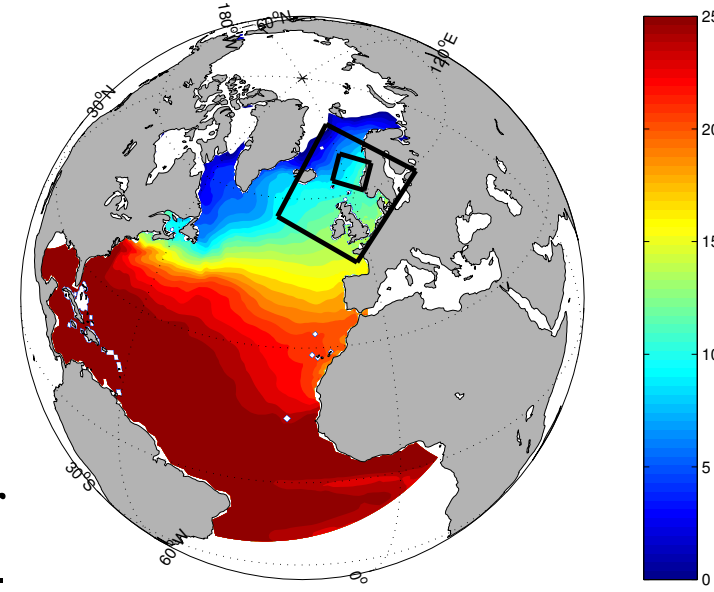
Physical model: Hybrid Coordinate Ocean Model

- 23 vertical layers
- KPP-mixing scheme
- Forcing with ERA40-fields
- A three-model system

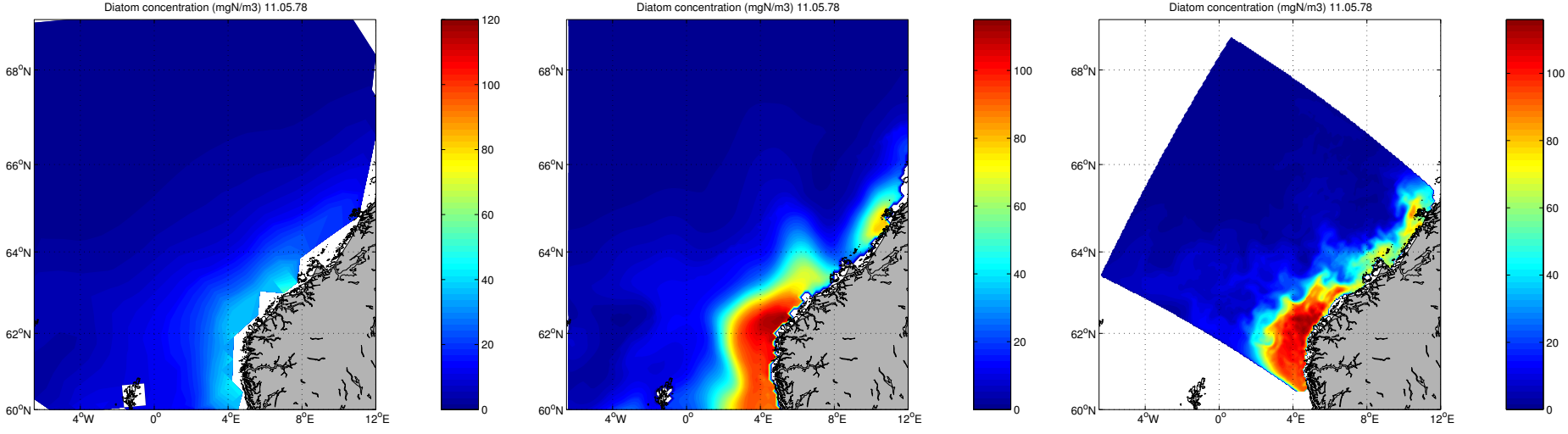


Nested system

- NorthAtlantic model, horizontal resolution: 50-80 km
- North Sea/Norwegian Sea model, horizontal resolution $\sim$ 15 km
- Small model of part of the Norwegian Sea, horizontal resolution $\sim$ 4.5 km
- Boundary conditions from outer model, including boundary conditions for the biological variables



Horizontal resolution



Concentration of Diatoms in may, 1978

Concentration increasing from left to right

Ecosystem model: NORWECOM

- NORWECOM: The NORWegian ECOlogical Model System
- 10 compartments
- 2 phytoplankton classes: Diatoms and Flagellates
- Nitrate, silicate and phosphate
- Detritus and biogenic silicate
- Oxygen
- Yellow substances and sediments

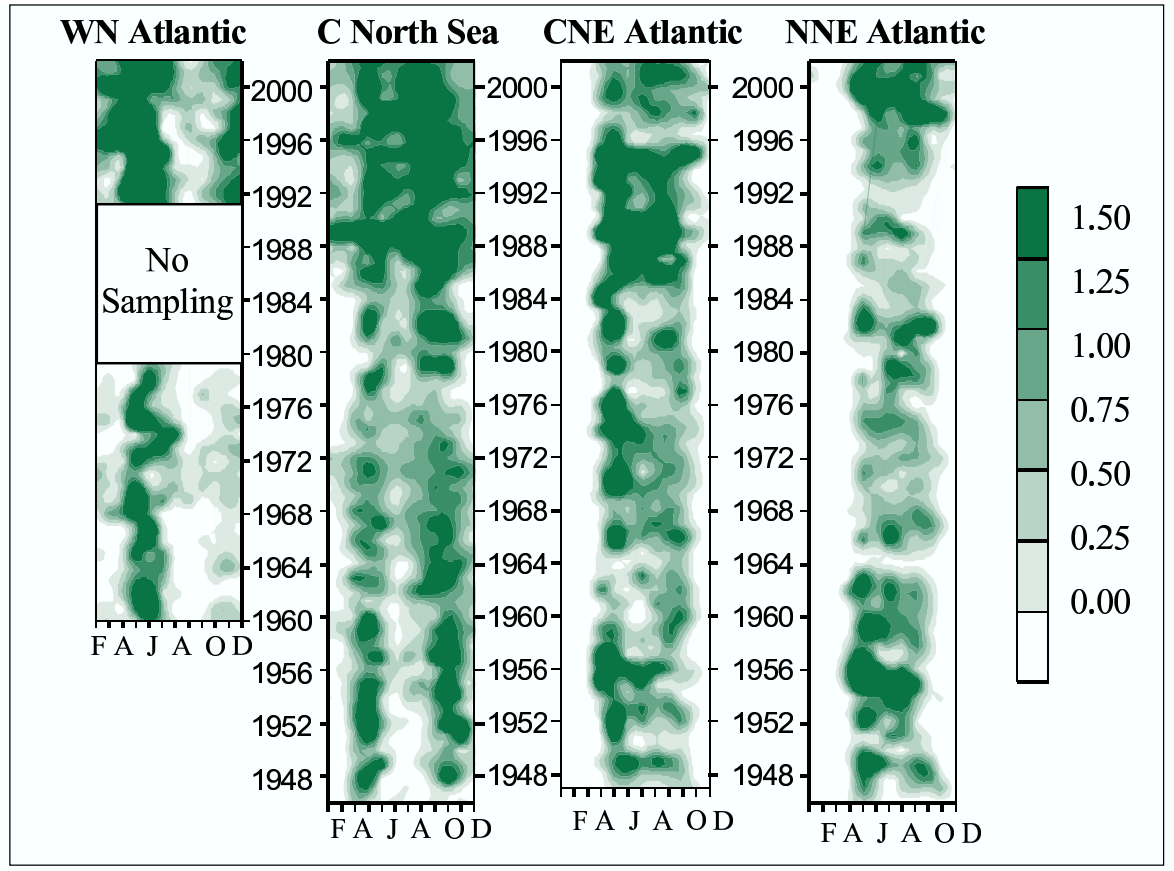
Skogen and Søiland 1998, Fisken og havet, nr.18

Ecosystem model

- Nutrients added by rivers
- Production limited by light or concentration of nutrients
- Aggregation/flocullation not included
- Death rate constant down to a minimum concentration of phytoplankton

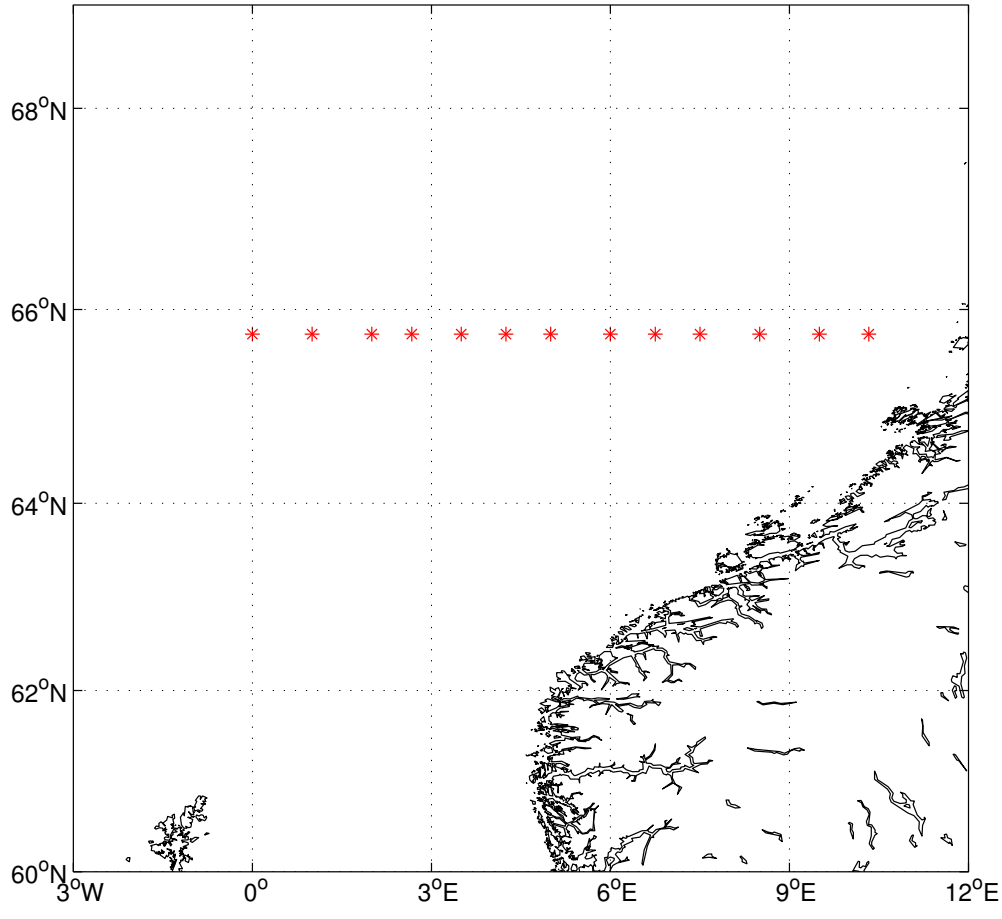
Skogen and Søiland 1998, Fisken og havet, nr.18

Connections between primary productivity and mesoscale activity?

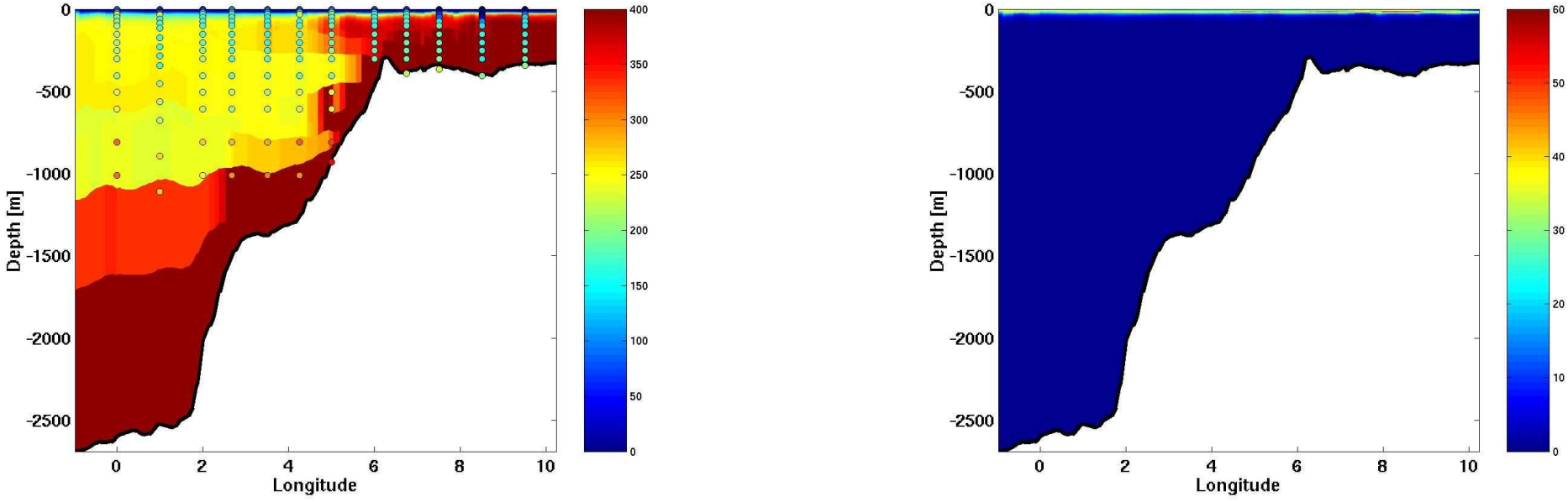


Reid et al. 1998,Nature,391,546 (updated)

Silicate/phosphate data



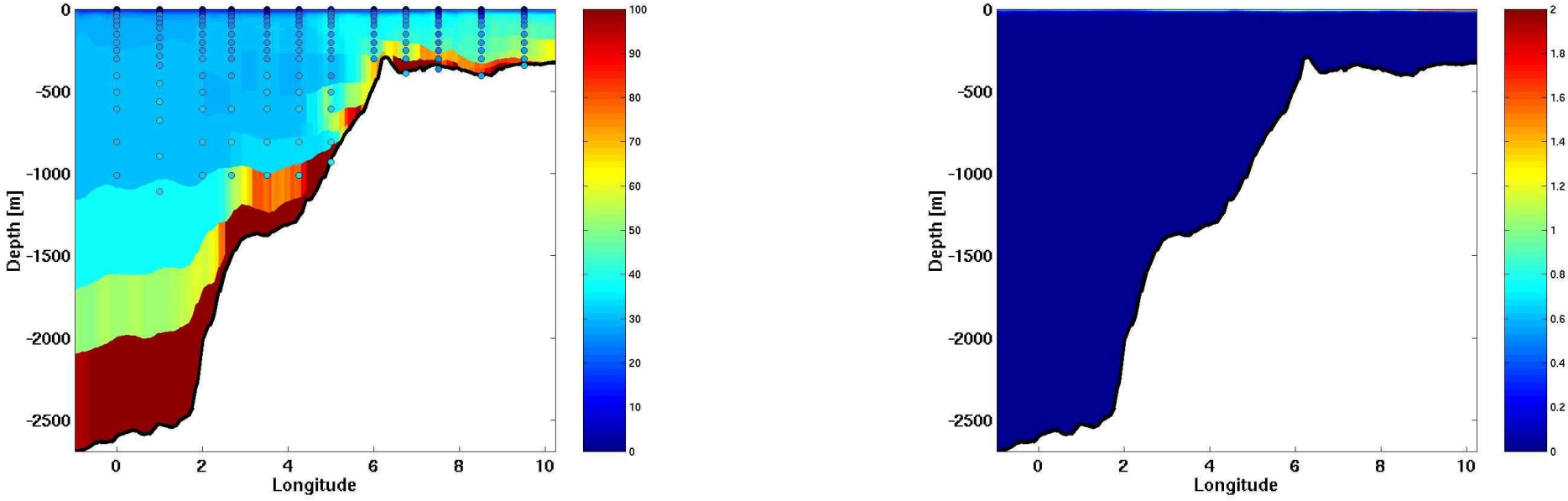
Comparison with data



Silicate (mgS/m3) and Diatoms (mgN/m3)

Data from www.ices.dk

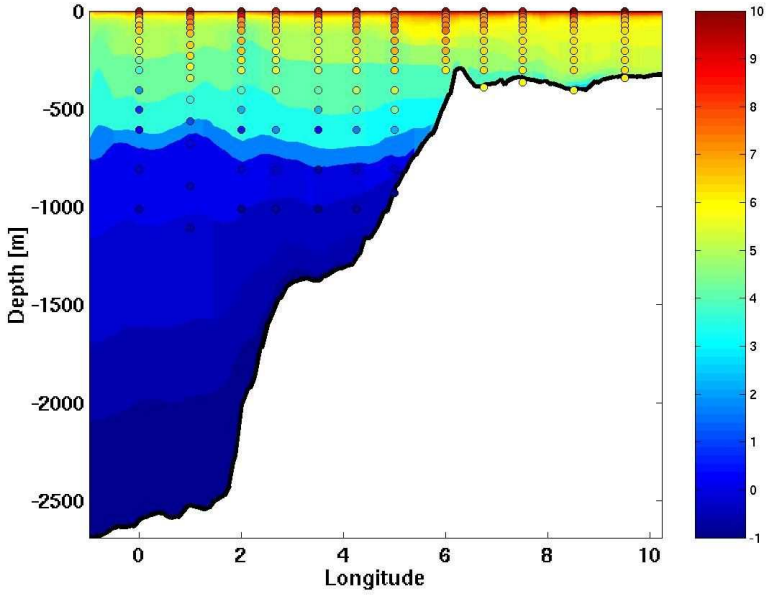
Comparison with data

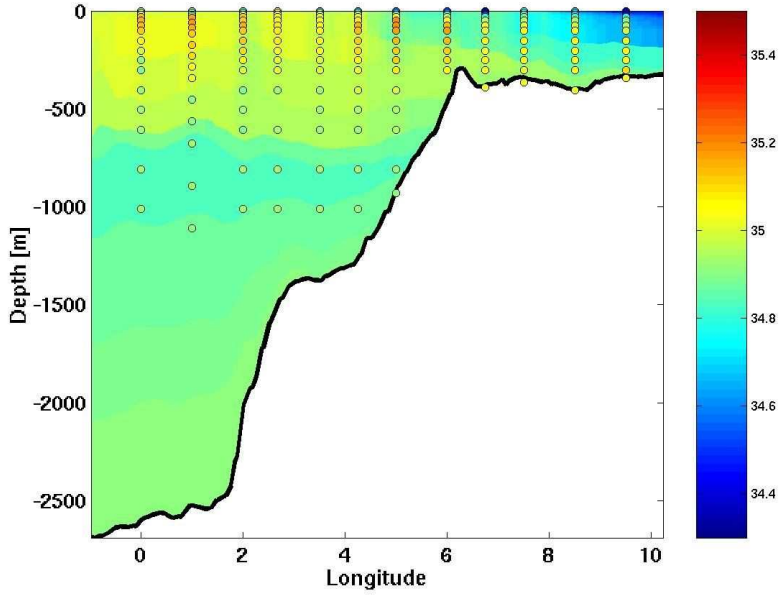


Phosphate (mgP/m3) and Flagellates (mgN/m3)

Data from www.ices.dk

Comparison with data

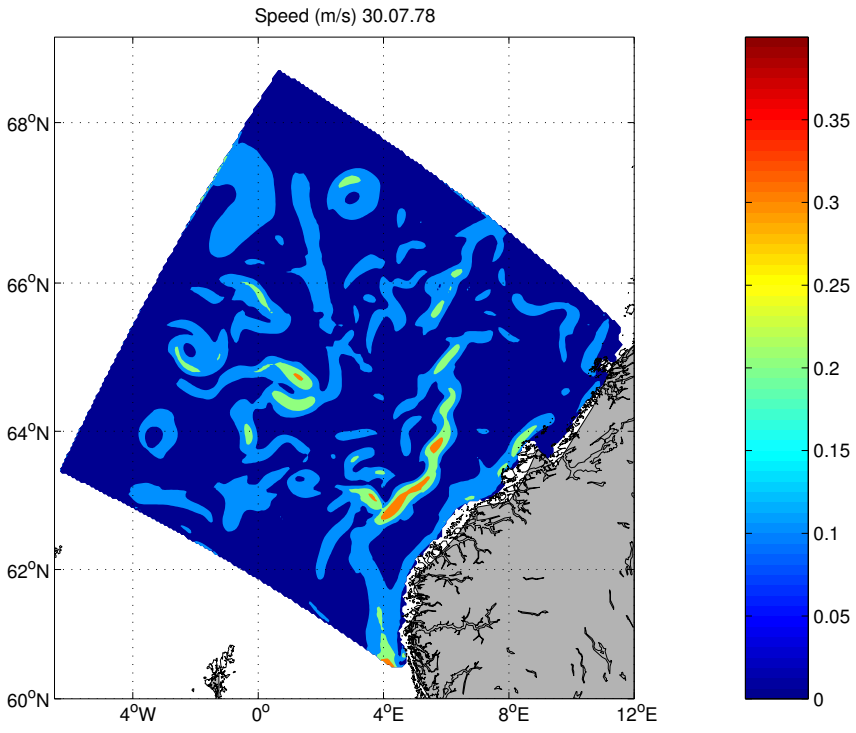


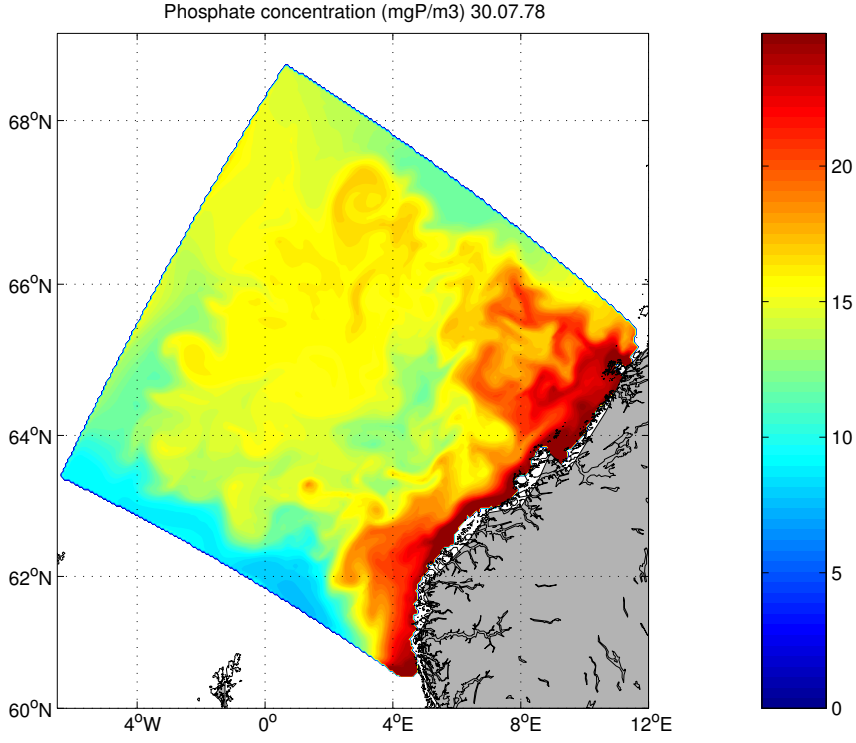


Temperature and Salinity

Data from www.ices.dk

Mesoscale activity and primary production





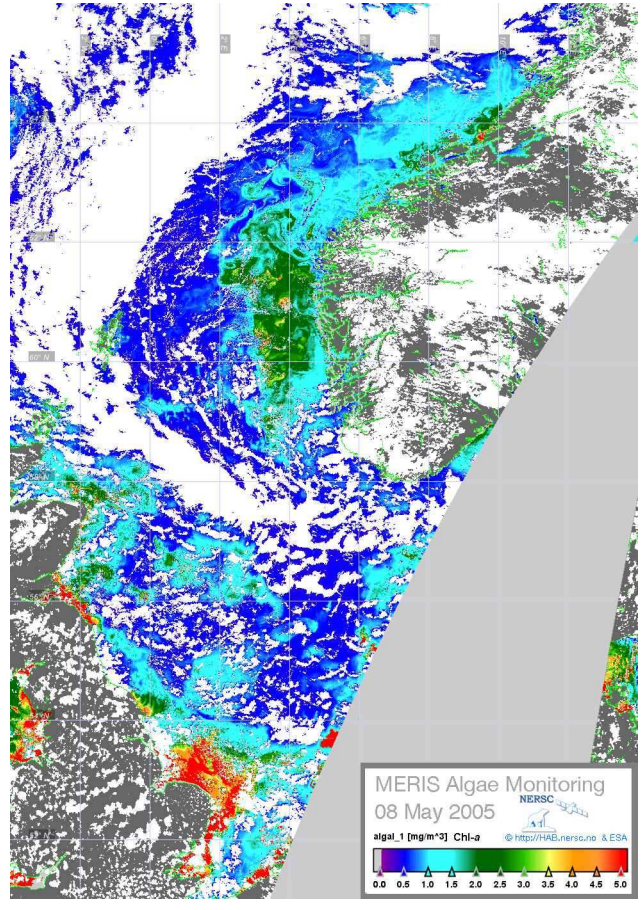
Future plans

- The influence of frontal dynamics on the marine ecosystem
- The influence of jump in NAO in 1995/1996 on the primary production in the Norwegian Sea
- Modelling the increased heatflux in the North Atlantic Current in 2002 and its possible influence on the primary production
- Providing food-fields for Zooplankton-model
- Sensitivity study of the inflow from the Baltic Sea on the primary production in the North Sea

Problems and wish-list

- Topograpy-following bottom layer of fixed depth would help the ecosystem-programming a lot!
- Path of the North Atlantic Current
- Good solutions or ideas for the sediment/resuspension in hycom?

THANK YOU!


MERIS Algae Monitoring
08 May 2005
NERSC
algal_1 [mg/m^3] Chl-a
© http://HAB.nersc.no & ESA
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

Equations for the biological parameters

$$
\begin{aligned}
\frac{\partial N}{\partial t} + adv(N) &= diff(N) + R_{Dia} + R_{Fla} \\
&+ cc_4 Det - (P_{Dia} + P_{Fla}) + \phi(N) \\
\frac{\partial P}{\partial t} + adv(P) &= diff(P) + cc_1(R_{Dia} + R_{Fla} \\
&+ cc_4 Det - (P_{Dia} + P_{Fla})) + \phi(P) \\
\frac{\partial Si}{\partial t} + adv(Si) &= diff(Si) - cc_2 P_{Dia} \\
&+ scc_4 Sis + \phi(P)
\end{aligned}
$$

Equations continues

$$
\begin{aligned}
\frac{\partial Det}{\partial t} + adv(Det) &= diff(Det) + cc_3(Dia + Fla) \\
&- cc_4 Det + \phi(Det) \\
\frac{\partial Sis}{\partial t} + adv(Sis) &= diff(Sis) + cc_2(R_{Dia} + cc_3 Dia) \\
&- scc_4 Sis + \phi(Sis) \\
\frac{\partial Dia}{\partial t} + adv(Dia) &= diff(Dia) + P_{Dia} - R_{Dia} \\
&- cc_3 Dia + \phi(Dia)
\end{aligned}
$$

Equations continues

$$
\begin{aligned}
\frac{\partial Fla}{\partial t} + adv(Fla) &= diff(Fla) + P_{Fla} - R_{Fla} \\
&- cc_3 Fla + \phi(Fla) \\
\frac{\partial Oxy}{\partial t} + adv(Oxy) &= diff(Oxy) + scc_1(P_{Dia} + P_{Fla} \\
&- -R_{Fla} - R_{Dia} - cc_4 Det) + \phi(Oxy)
\end{aligned}
$$