The influence of horizontal model grid resolution on modelled primary production in the Norwegian Sea

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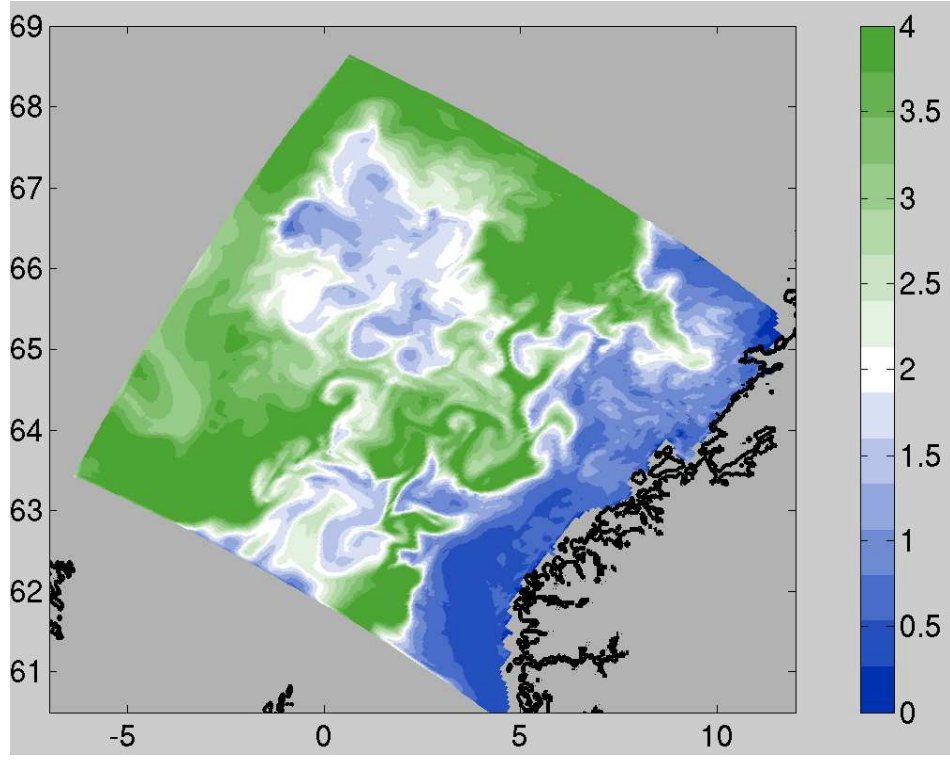
Outline

- Objective
- Model grids used in the experiment
- Ecosystem model
- Results
- Conclusions

Objective

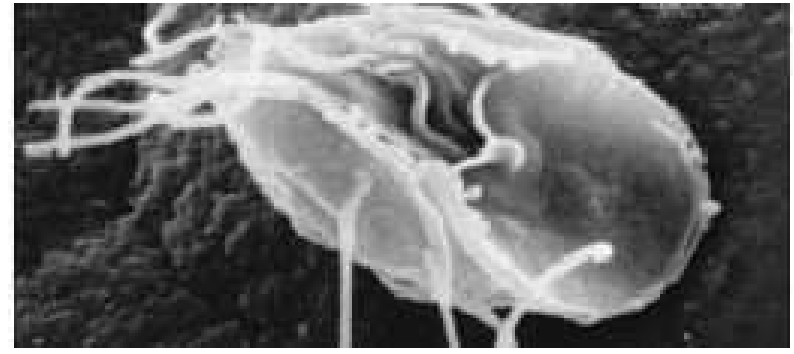
Objective: Explore the magnitude of the effect from mesoscale activity on a coupled ecosystem-physical model system.



Daily primary production(gC/m^2)
from diatoms, julianday 145, 1995

Ecosystem in the Norwegian Sea

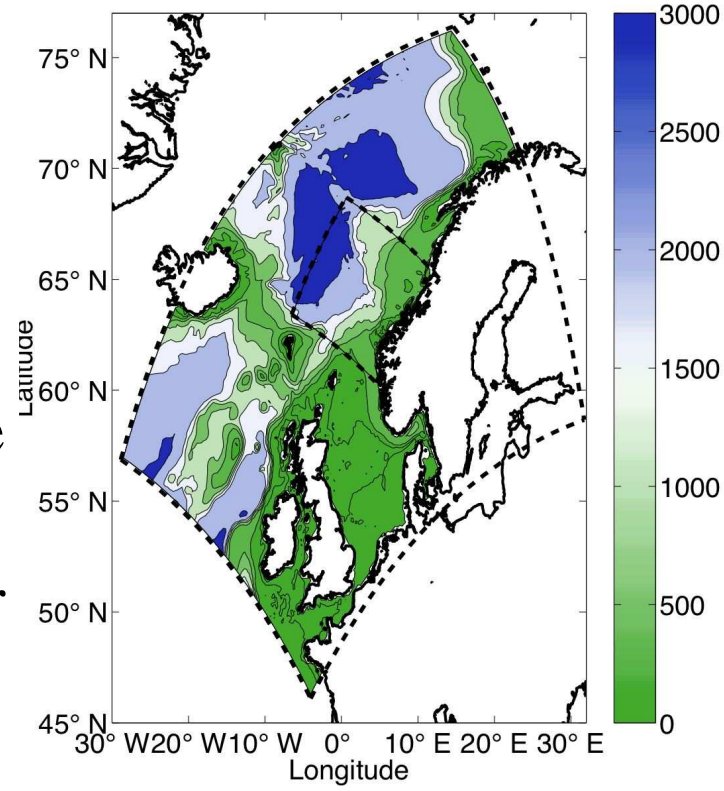
- Two key phytoplankton species: Diatoms and flagellates
- Springbloom triggered by shoaling of mixed layer
- Food source for zooplankton



http://no.wikipedia.org/wiki/Giardia

Model grids

- Three model grids in the focus area
- Horizontal resolution in focus area: 50km - 16km - 4.5km (MODL, MODM, MODS respectively)
- Same vertical distribution in all three model grids, 23 vertical layers
- Nesting conditions from larger model, also biological parameters



Ecosystem model: NORWECOM

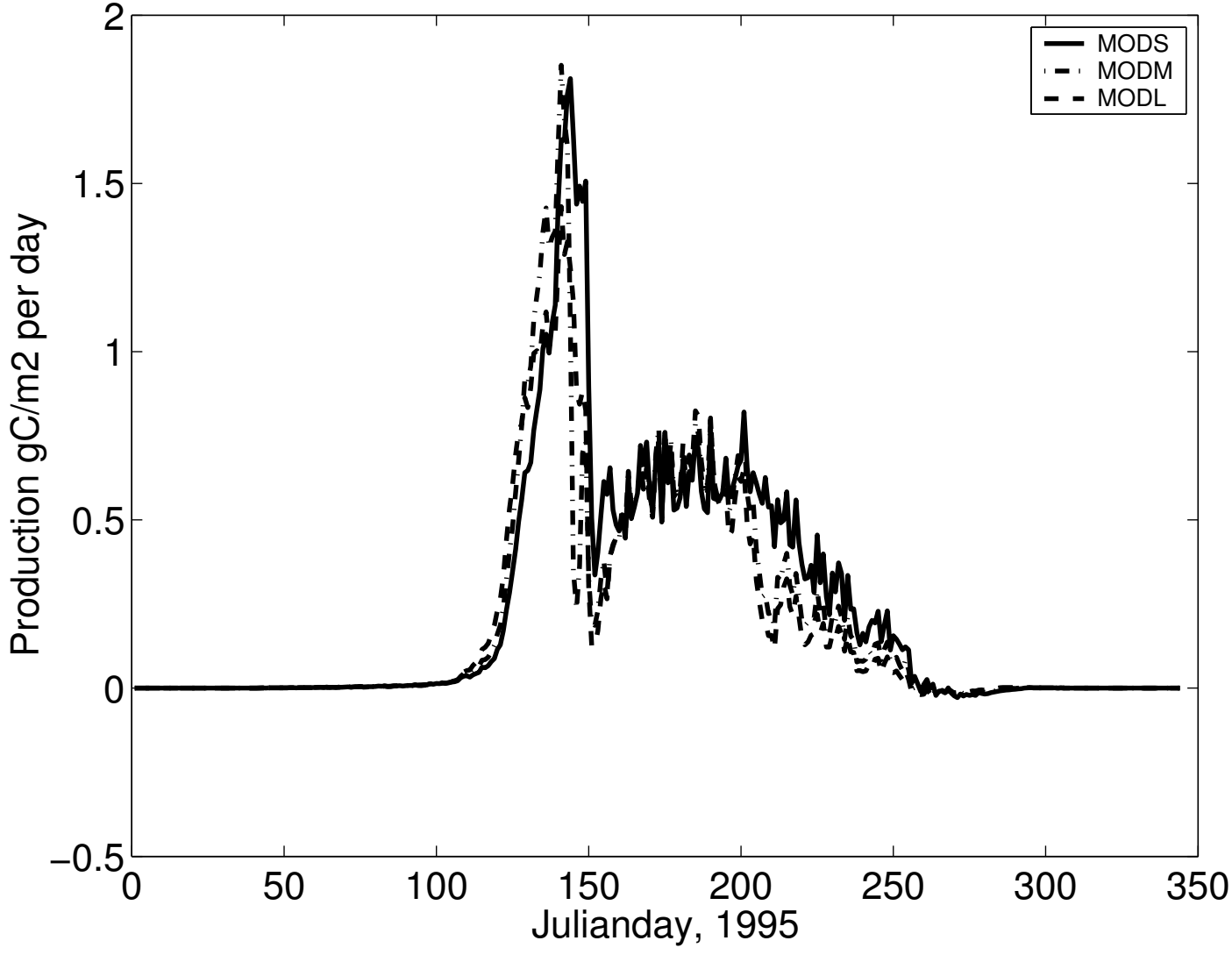
- Ten components, including two phytoplankton classes (diatoms and flagellates)
- Nitrate, phosphate and silicate
- Detritus and biogenic silica
- Oxygen, sediments and yellow substances

Results

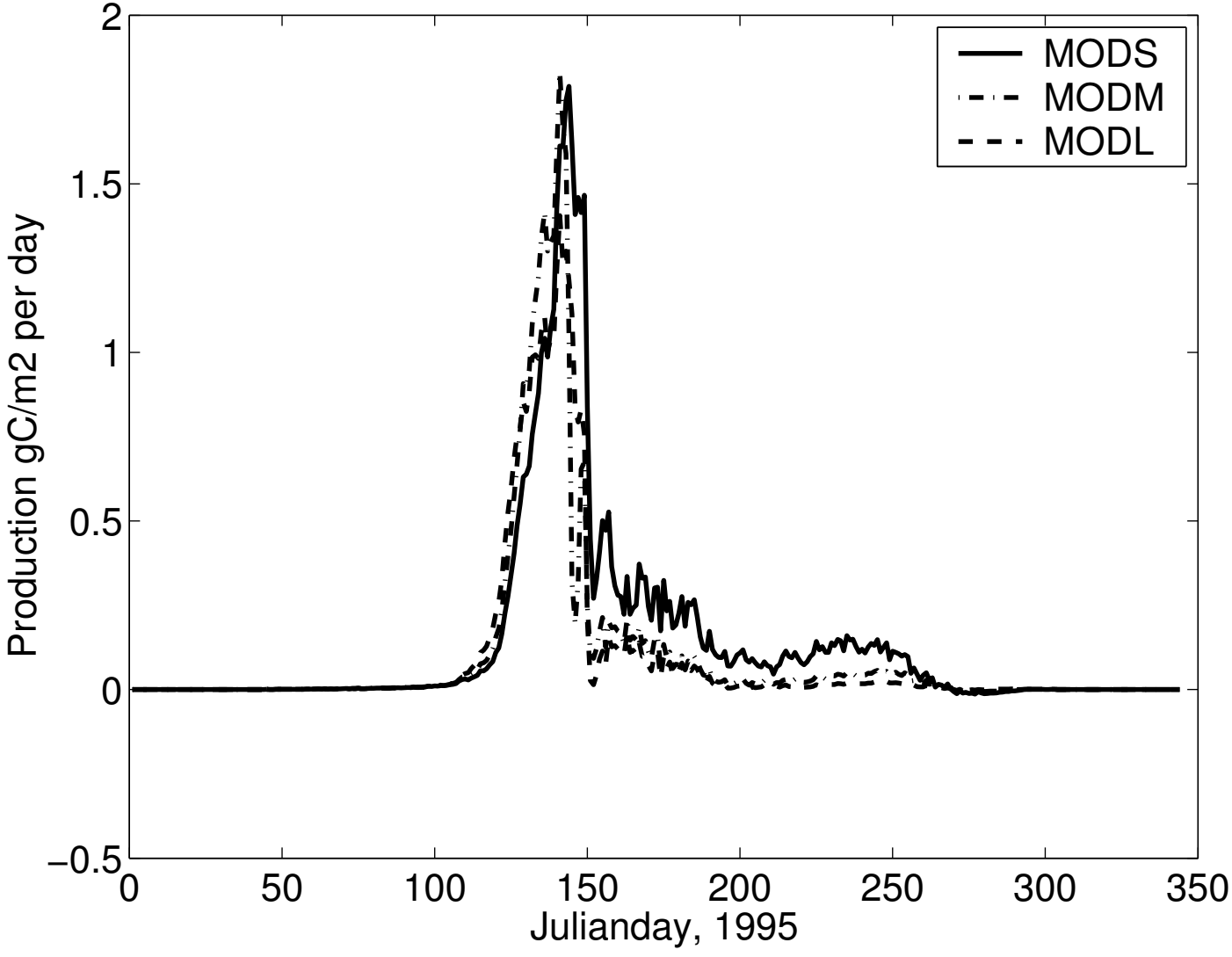
Two main results:

- Only when the Rossby radius is reached, the differences in results become significant
- The composition of the phytoplankton groups included in the ecosystem model change when the mesoscale activity is resolved

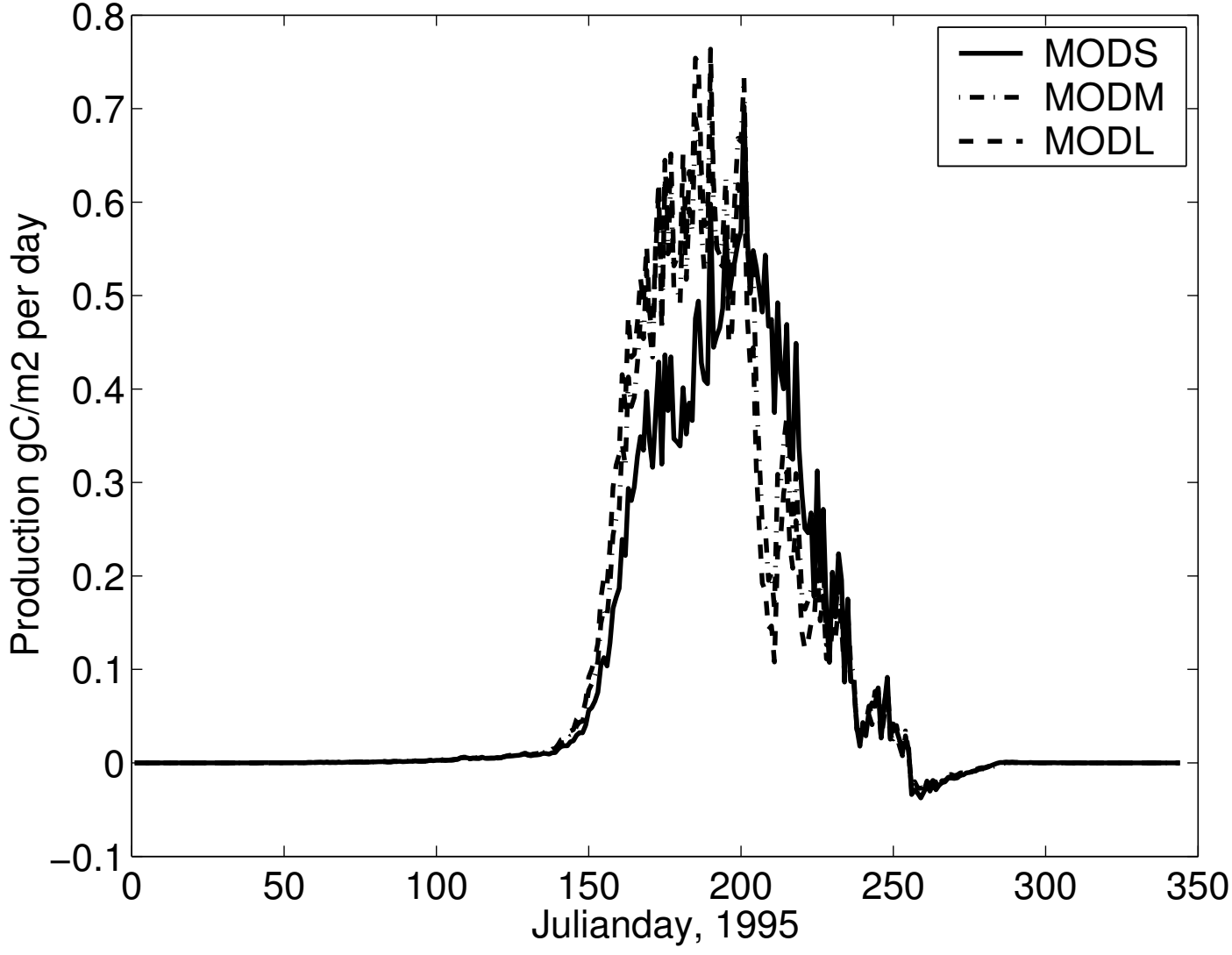
Results: Net primary production



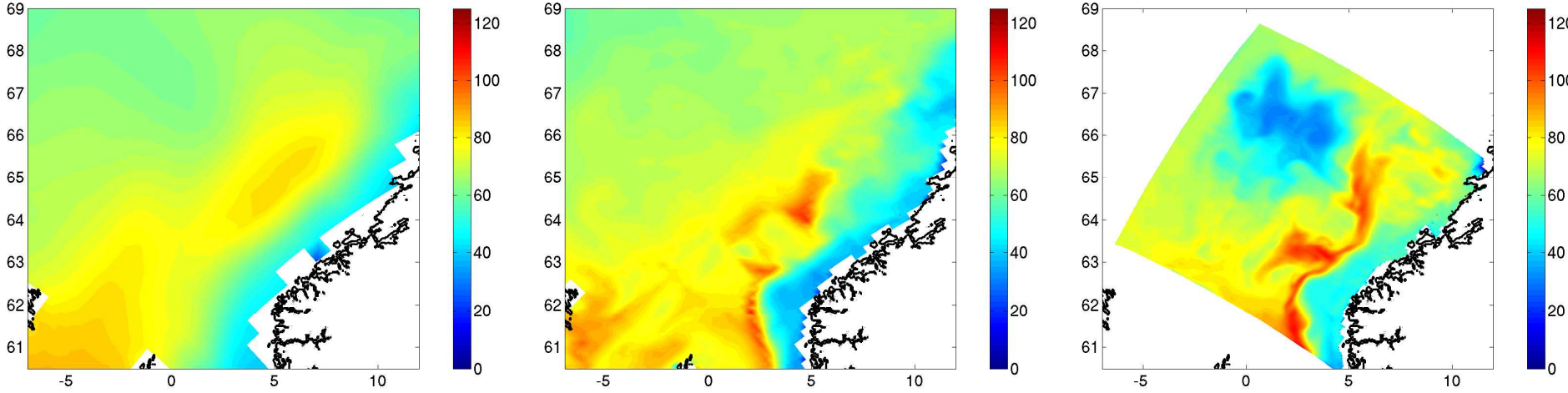
Results: Diatom net primary production



Results: Flagellate net primary production



Results: Annual flagellate primary production

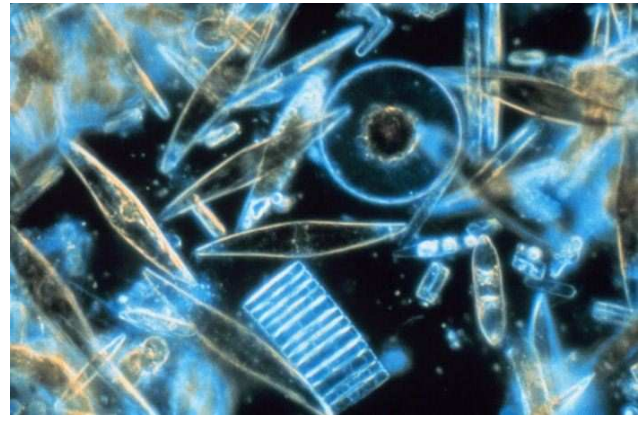


Annual flagellate primary production (gC/m^2), in (from left) MODL, MODM and MODS

Conclusions and future work

- Overall increase in primary production when resolving the mesoscale activity
- Expect more changes if the horizontal model grid resolution is further increased
- Changes in the phytoplankton population due to transport of nutrients into the euphotic zone

THE END!



(from http://en.wikivisual.com/index.php/Cell_wall)

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

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