Zooplankton-phytoplankton interactions simulated by combining distinct modeling approaches in the Norwegian Sea

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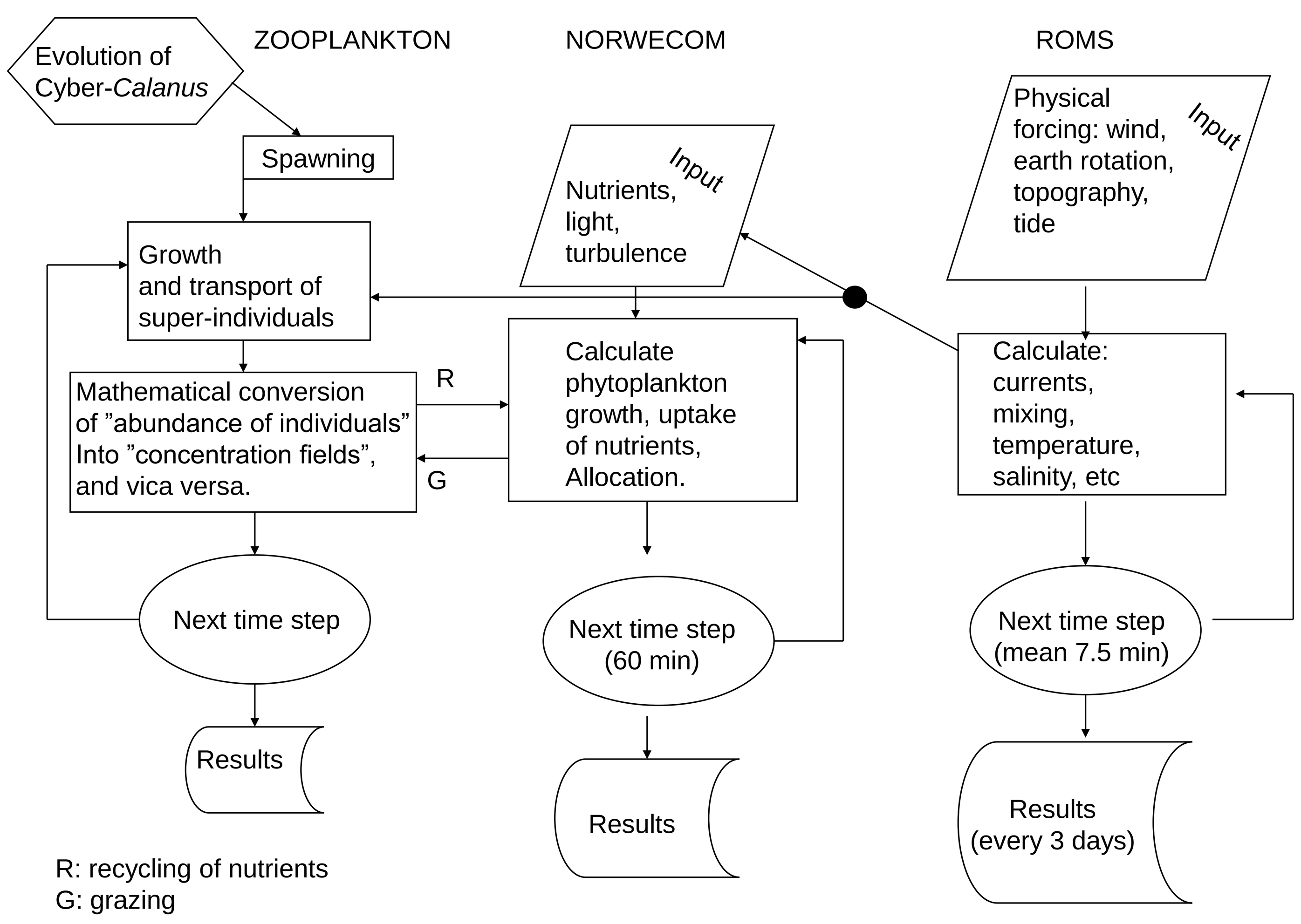
Calanus finmarchicus is the dominant herbivorous mesozooplankton in the Norwegian Sea and has the potential for impacting strongly on the population dynamics of phytoplankton. We have developed a novel individual based *Calanus* model with simulated evolution of behavioural traits, including vertical migration strategies and timing of ontogenetic migrations. The results show that the simulated *Calanus* population is able to remain viable in the Norwegian Sea basin over hundreds of years and evolves a life history that resembles the observed life history of *C. finmarchicus.*

The model

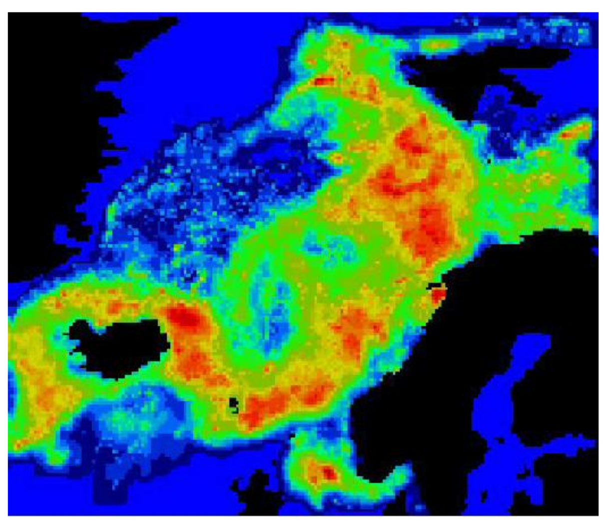
Zooplankton are usually modelled individually, whereas phytoplankton models are preferrably based on biomass concentrations. We have combined these approaches specifically to address interactions between zooplankton and phytoplankton:

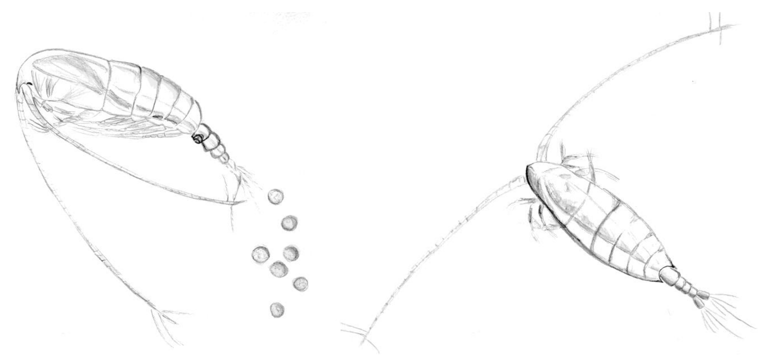


Phytoplankton biomass was simulated by a newly developed model, based on a ROMS physical model and a modified NORWECOM model for phytoplankton, and linked with the zooplankton model.

Zooplankton results from the modeling:

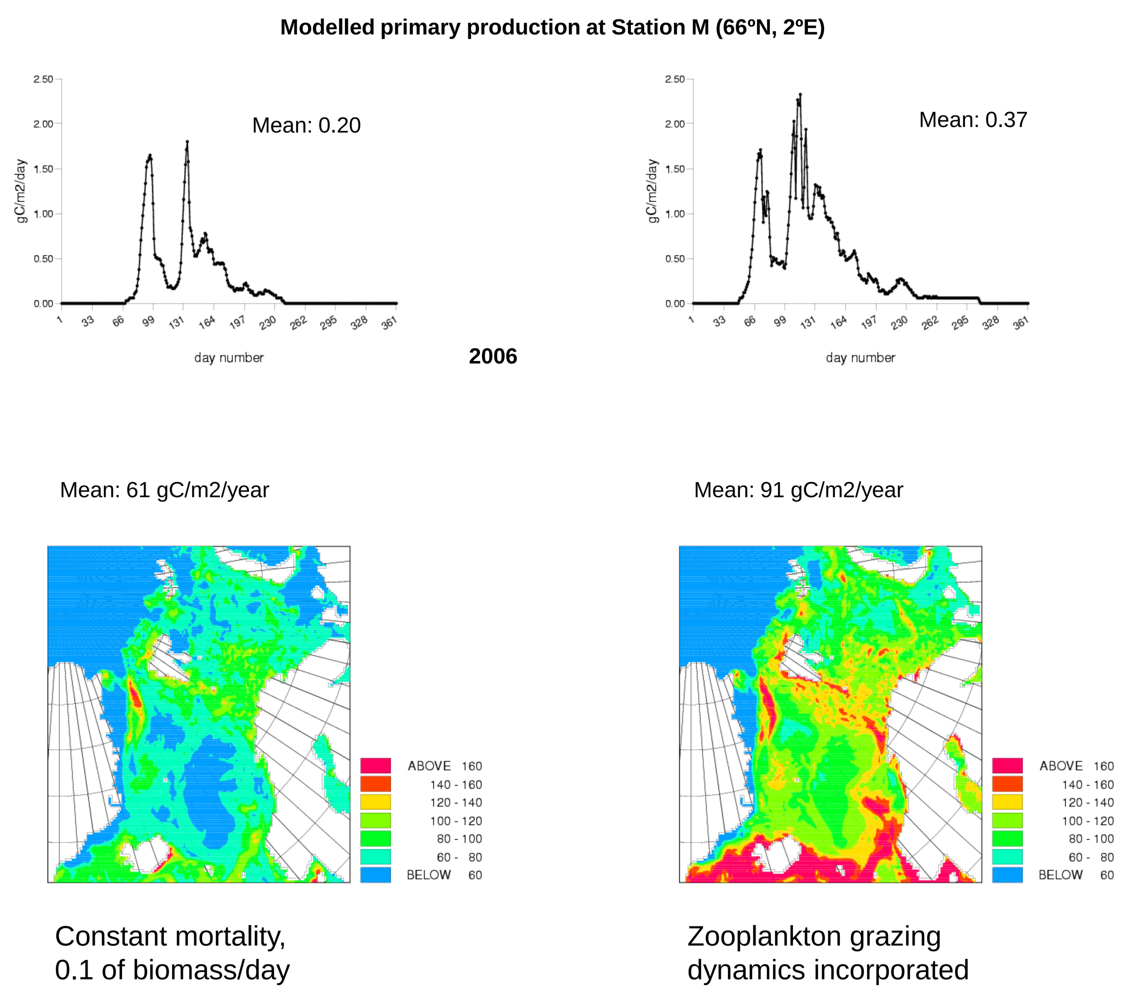
Modelled distribution of *C. finmarchicus* in January. Colour scale (ind m^{-2}): red ≈ 35 000, green ≈ 10 000, blue < 5 000.





The model predicts a higher abundance of *C. finmarchicus* in the southern part of the Norwegian Sea and along the Norwegian shelf than generally is observed in the field.
Examples from simulating climatically quite different years demonstrate a significant bottom up regulation of the *Calanus* production and distribution, which may affect recruitment, growth, and migration pattern of planktivorous fish such as herring (drawing by Åse Husebø).

Phytoplankton results from the modeling



Linking *Calanus* grazing in the individual based zooplankton model to phytoplankton mortality has a profound effect on the population dynamics of phytoplankton (right part of figure), compared with the constant mortality parameter implementation previously applied in NORWECOM (left part). Most notably the phytoplankton bloom is prolonged and the primary production increases when dynamic grazing is incorporated in the model.

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