Impact of the implementation of the diapause trait on the dynamics of plankton communities and the carbon cycle in a numerical pelagic Arctic ecosystem

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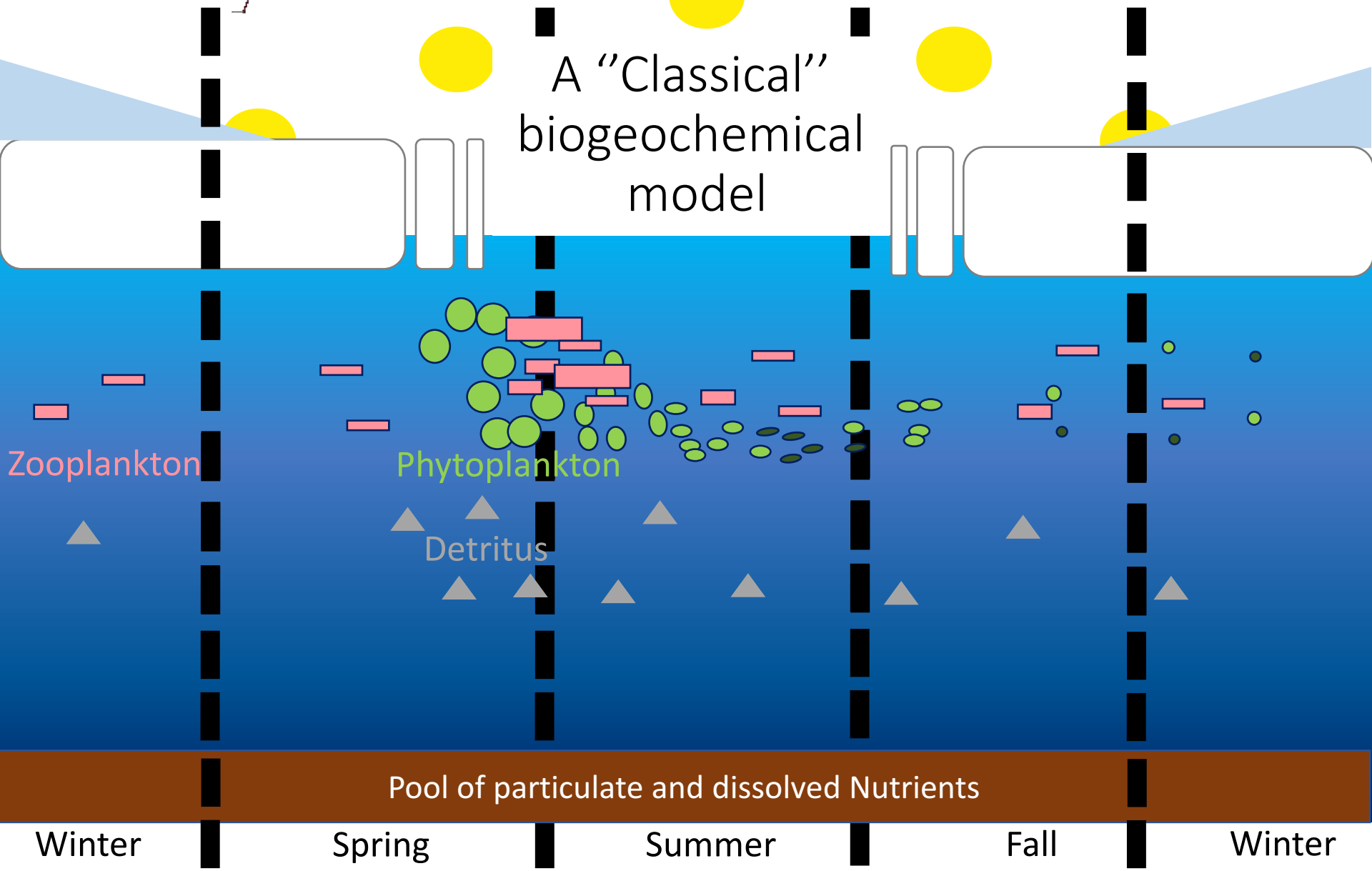
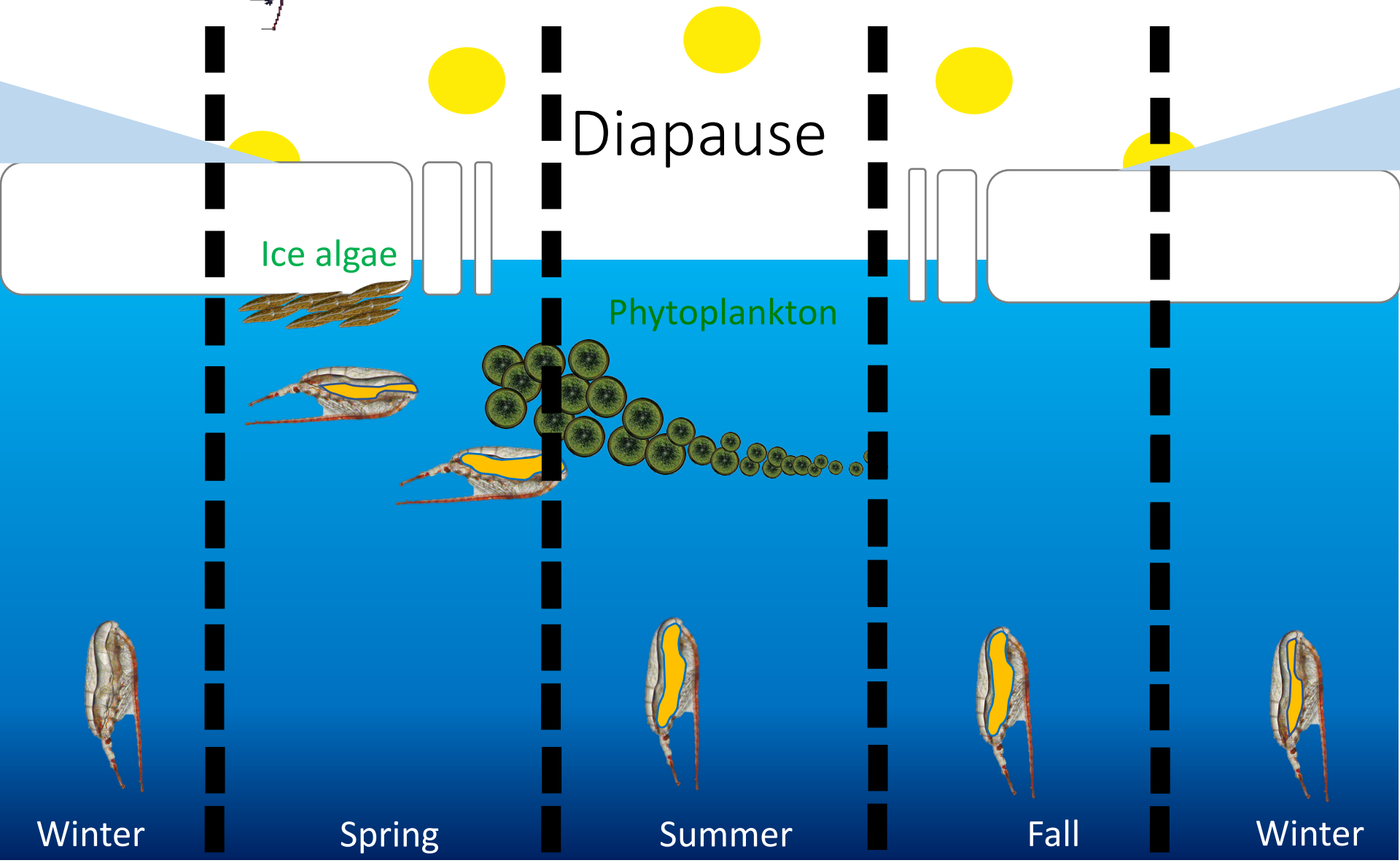
A "Classical" biogeochemical model




Diapause
Ice algae
Phytoplankton
Winter
Spring
Summer
Fall
Winter

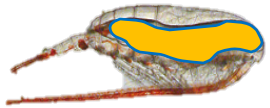
Objective

To implement the diapause trait in order to have a realistic representation of survival of copepods in a numerical arctic pelagic ecosystem

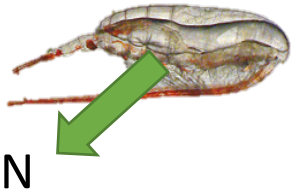
Diapause

Lipid concentration as a proxy to trigger entering/exiting diapause
(Lipid Accumulation Window, Maps et al. 2011)

Start



Control on diapause



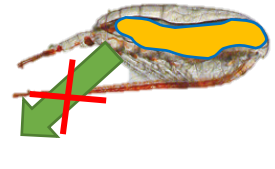
Before diapause

Decrease of the respiration

Lipid concentration

No nitrogen excretion

Several months later



During diapause

C:N ratio

High lipid concentration

High C:N

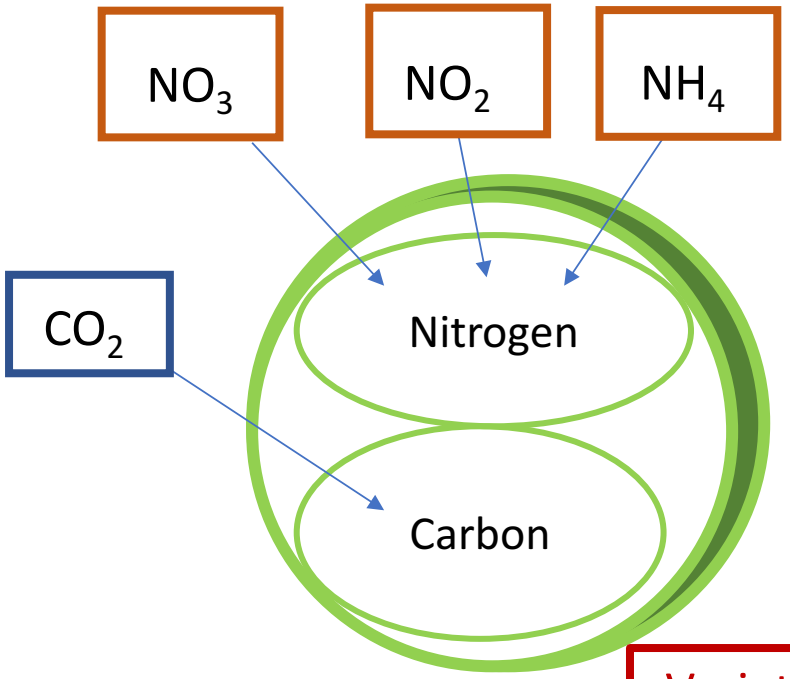
C:N as a proxy for the lipid concentration

Low lipid concentration

Low C:N

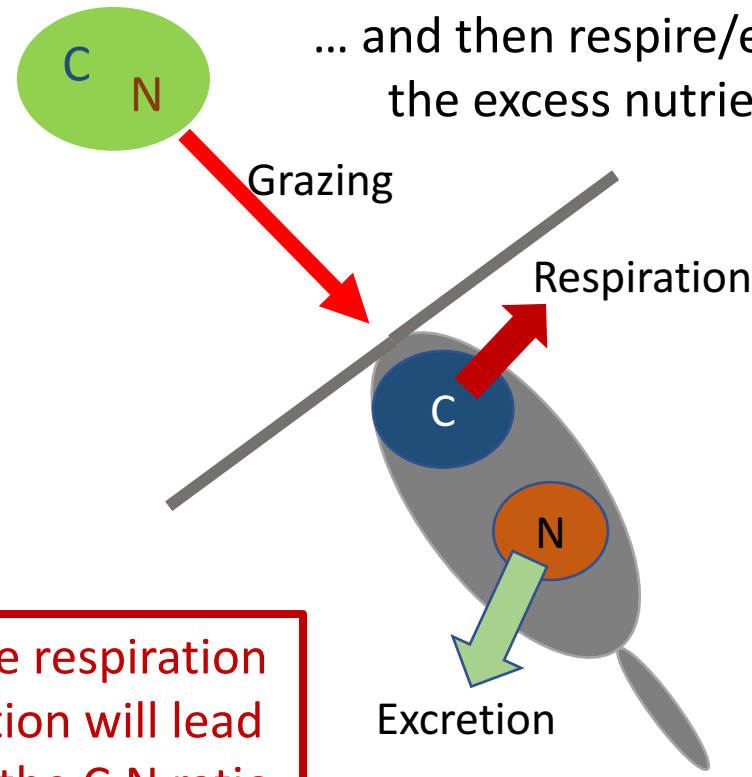
Use of quotas

Phytoplankton can select the nutrients it needs



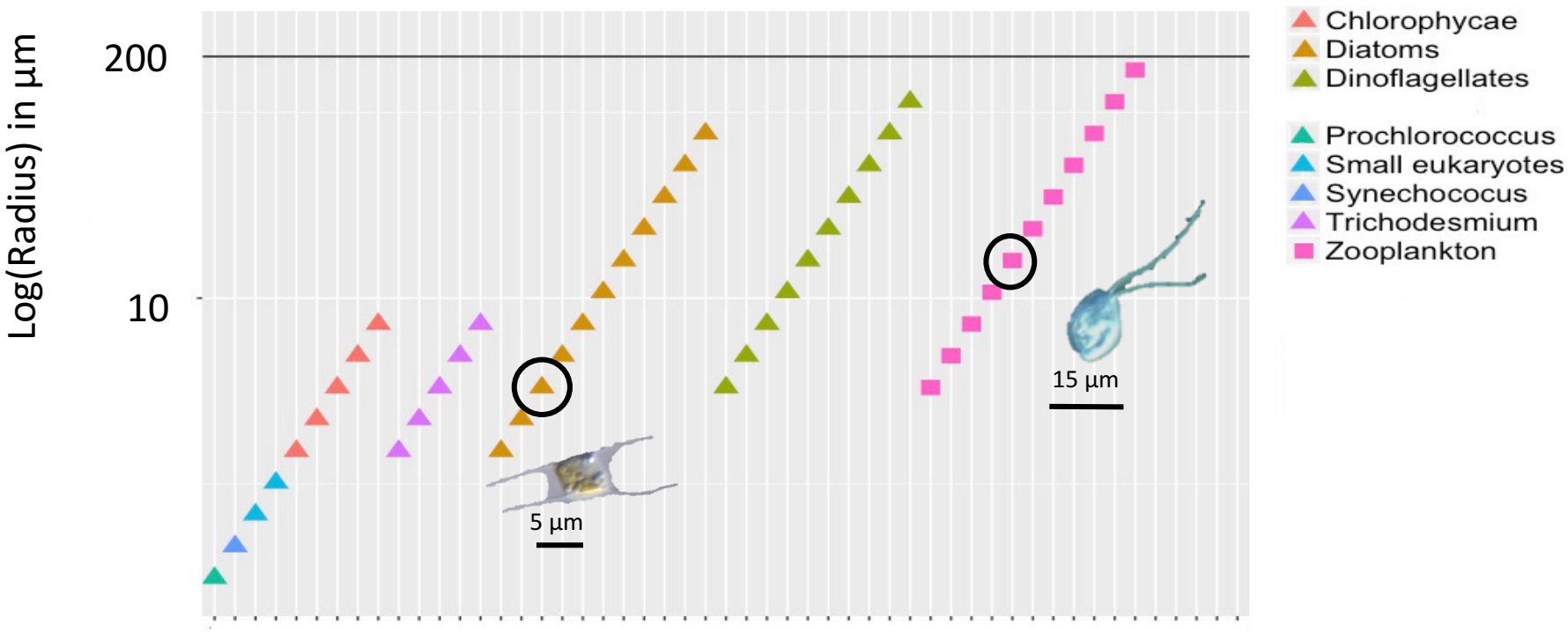
Zooplankton get all their nutrients in bundle…

… and then respire/excrete the excess nutrients

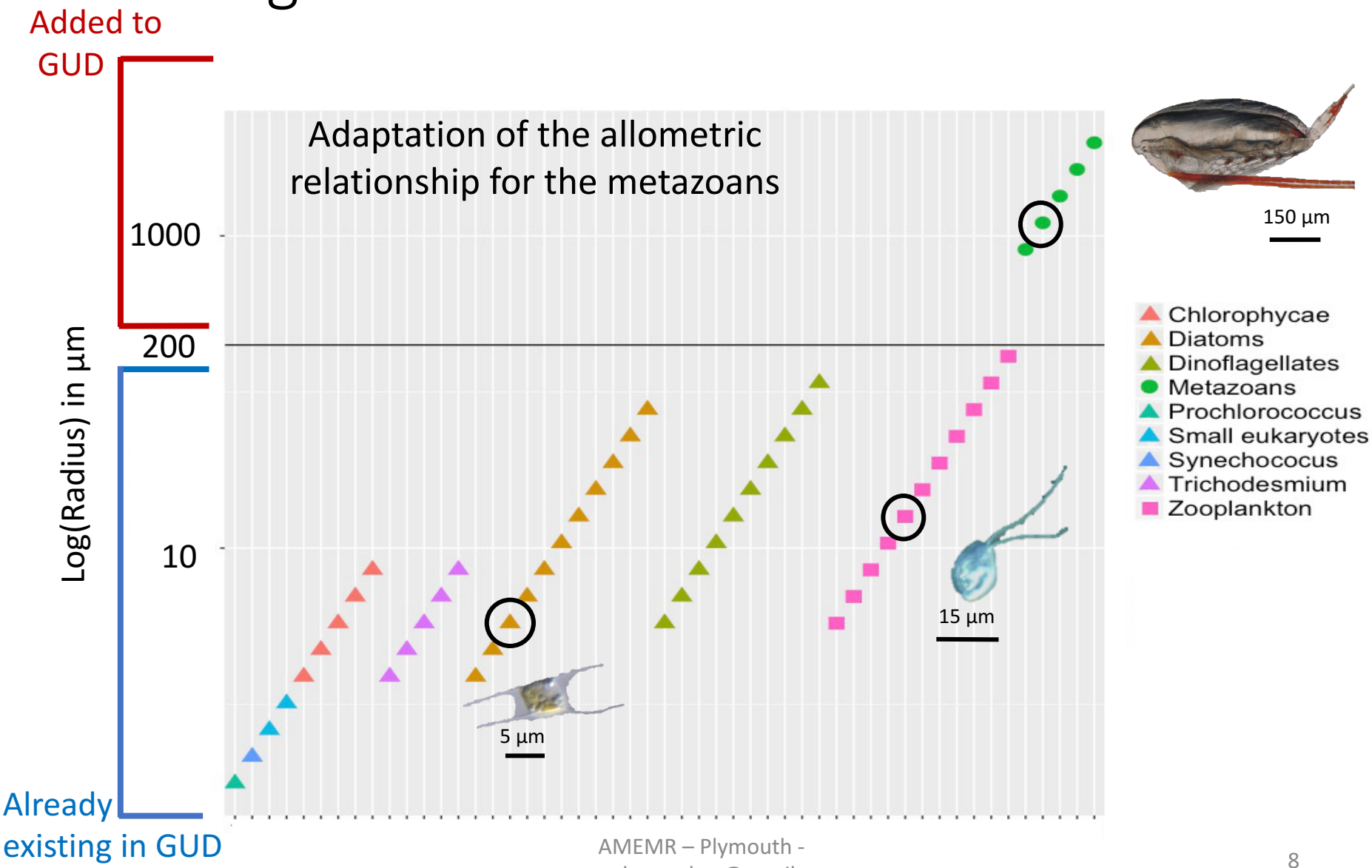


Variation in the respiration and the excretion will lead to variation in the C:N ratio

Biogeochemical model Darwin - GUD

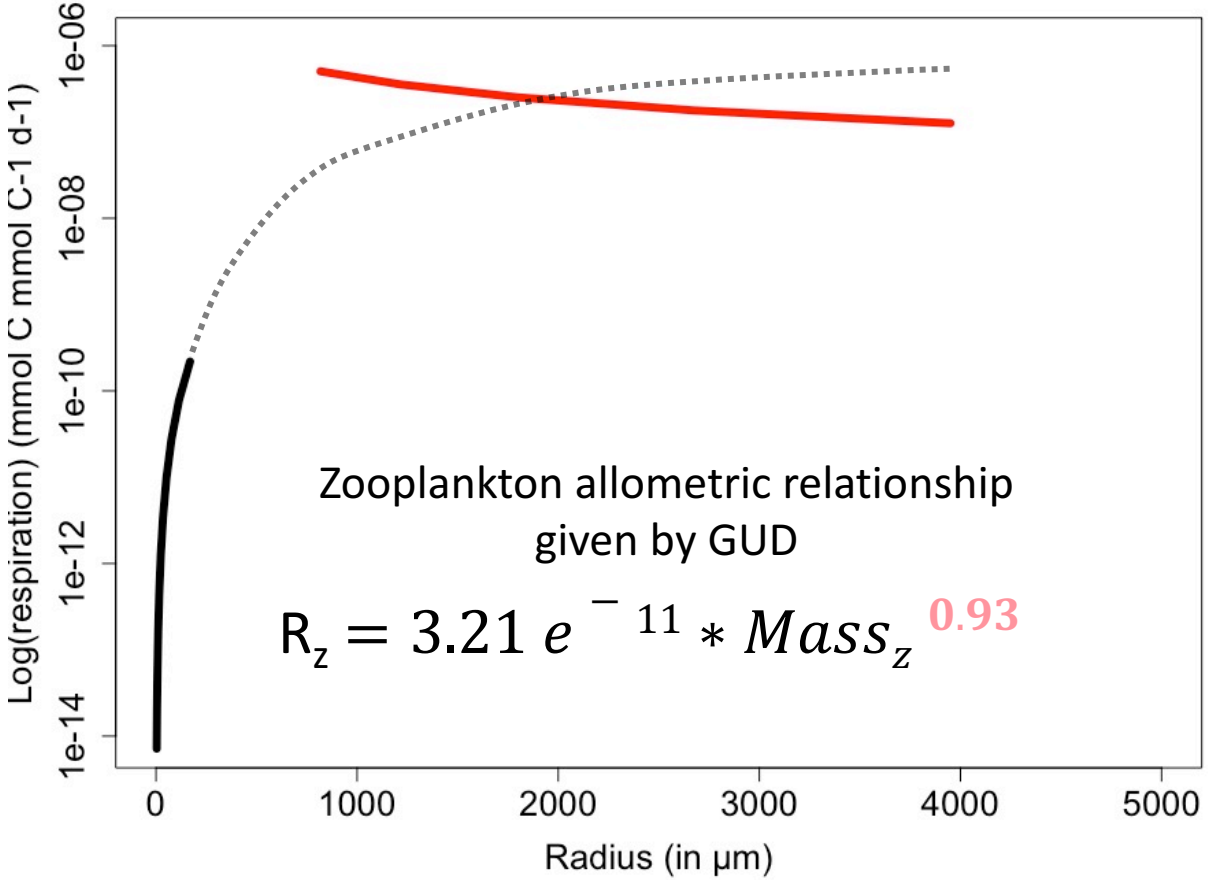


Biogeochemical model Darwin - GUD



Adaptation of the allometric relationship for the metazoans

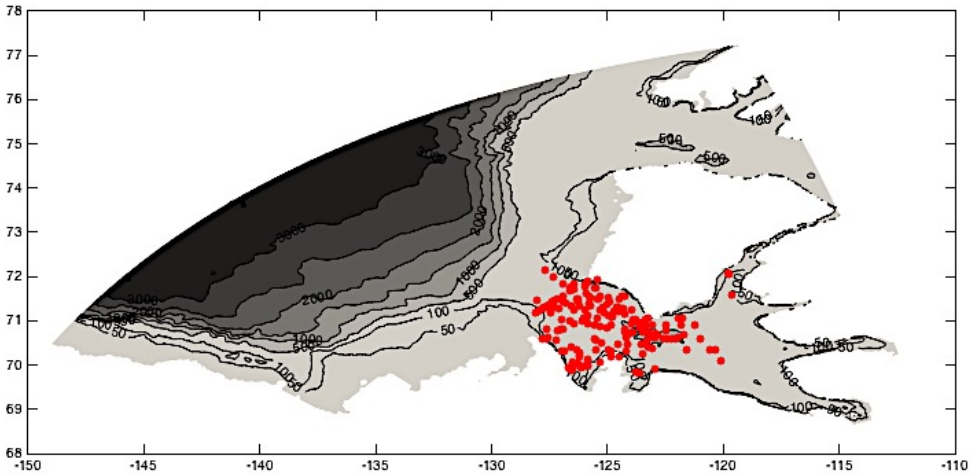
There was no active respiration or excretion for the zooplankton in GUD (even though the mechanisms were present)



Metazoan adapted allometric relationship

$$R_m = 15 * Mass_m^{-0.312}$$

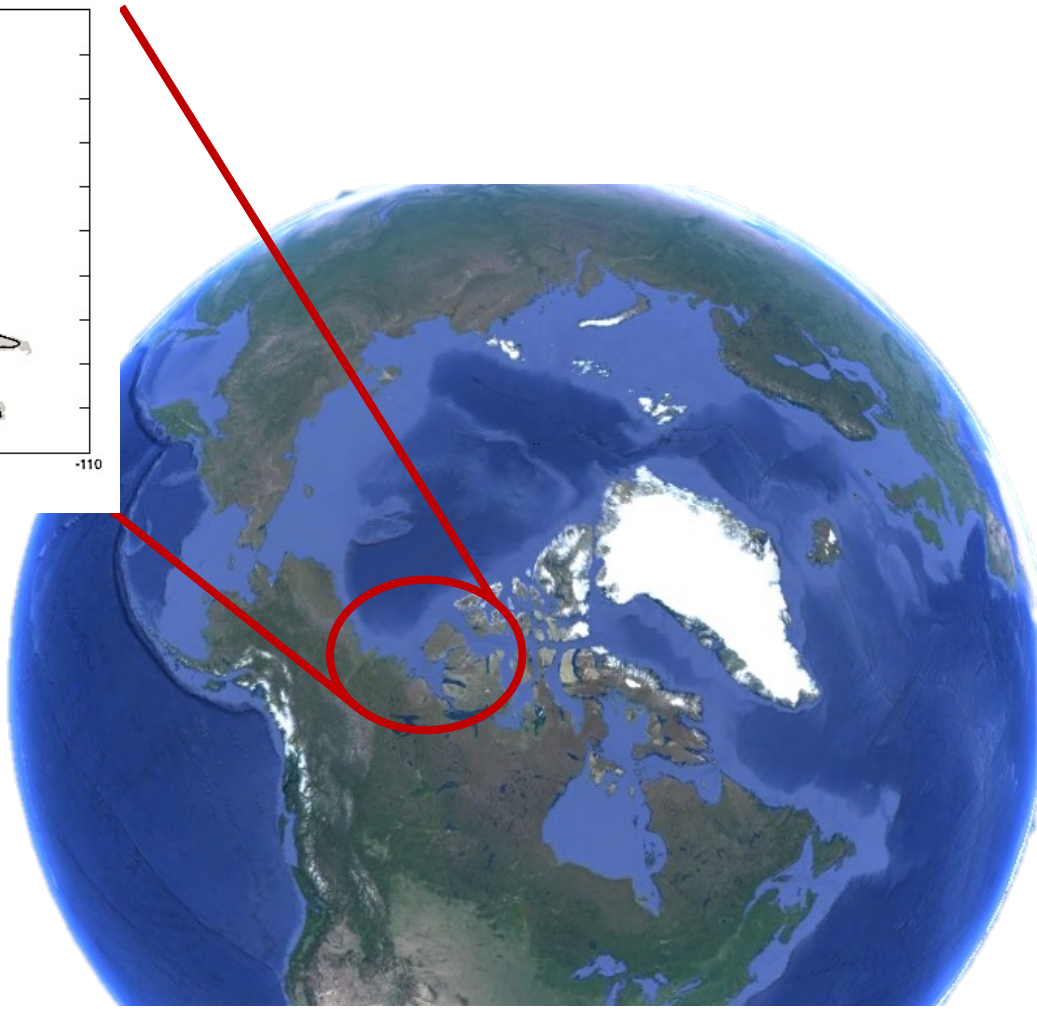
The Amundsen gulf



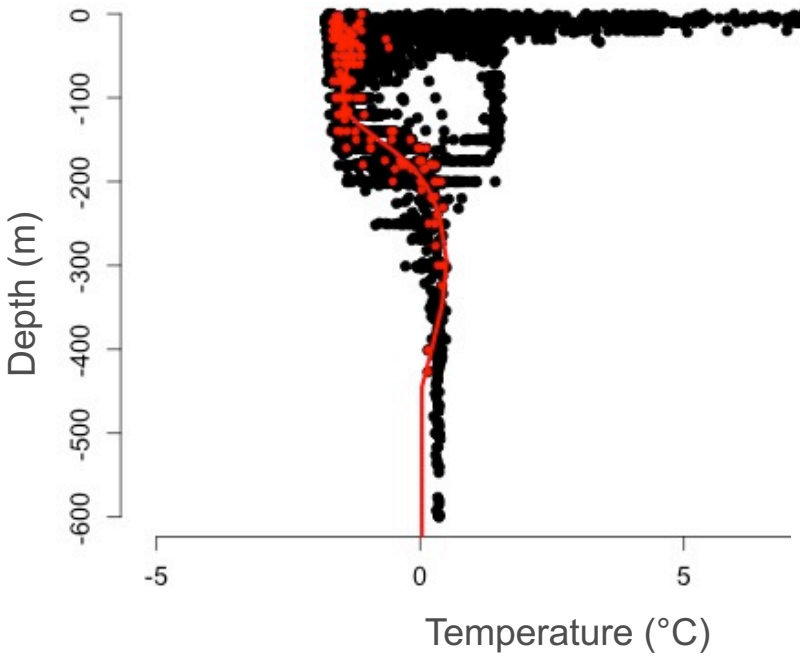
Source: Christiane Dufresne

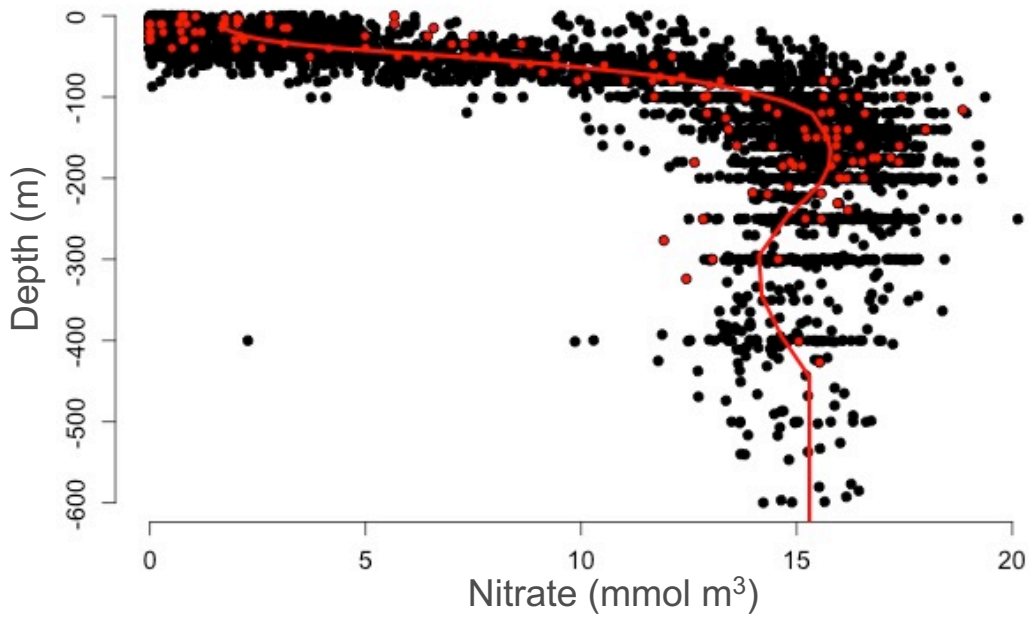
One of the most well known areas of the Canadian Arctic Archipelago

1D configuration

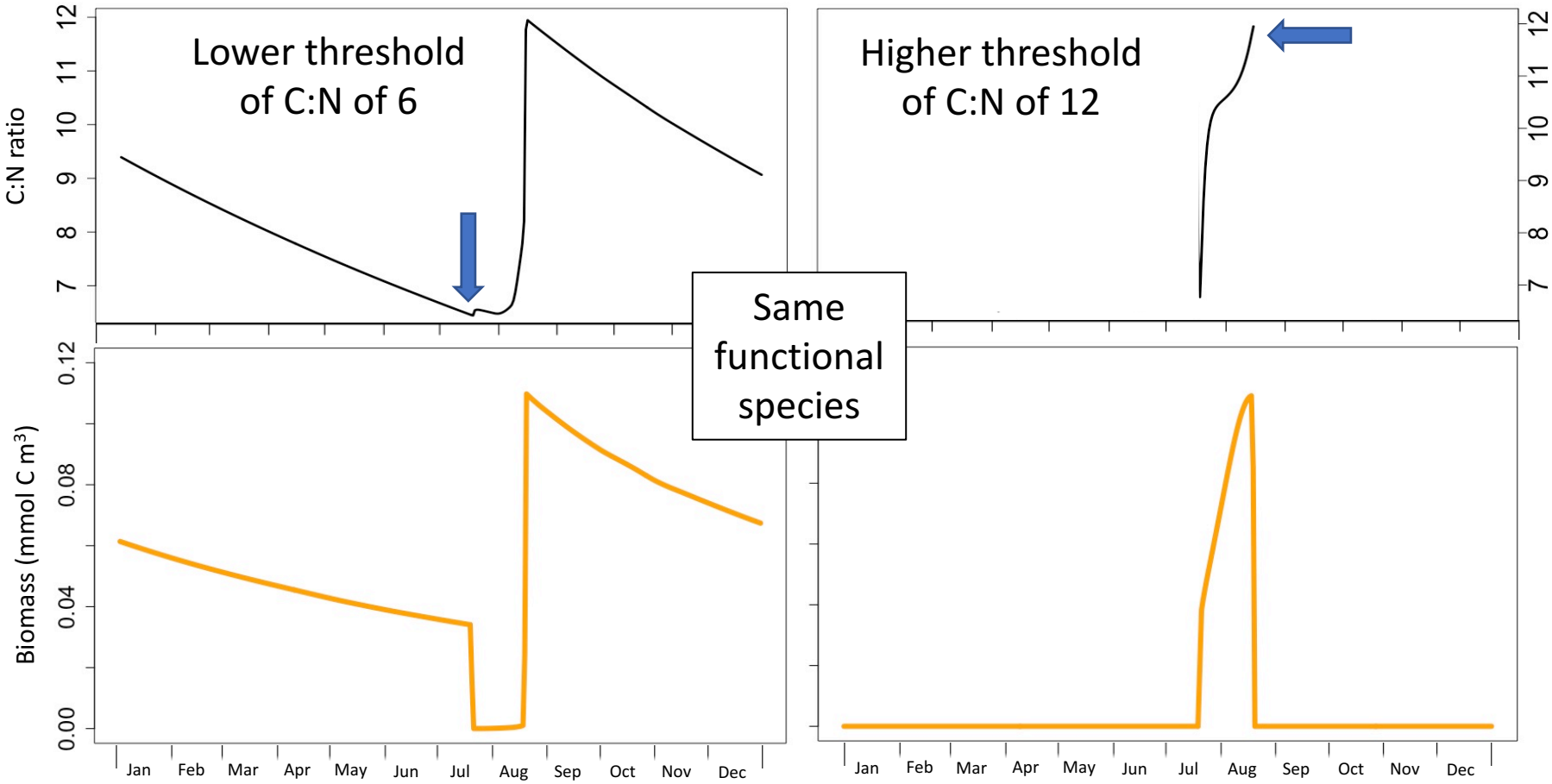


Abundance of environmental data





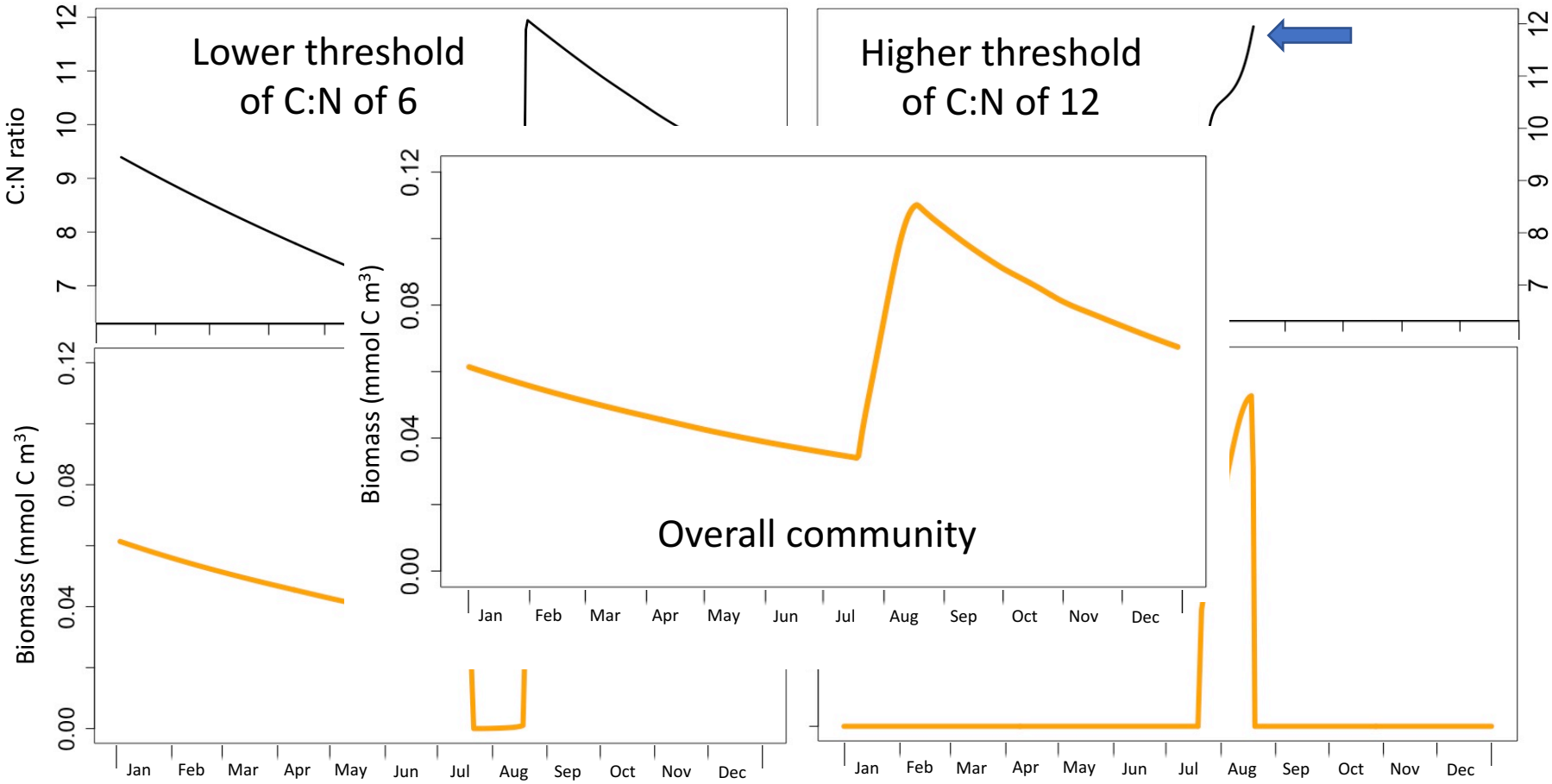
Entry and Exit of Diapause



In diapause

Active

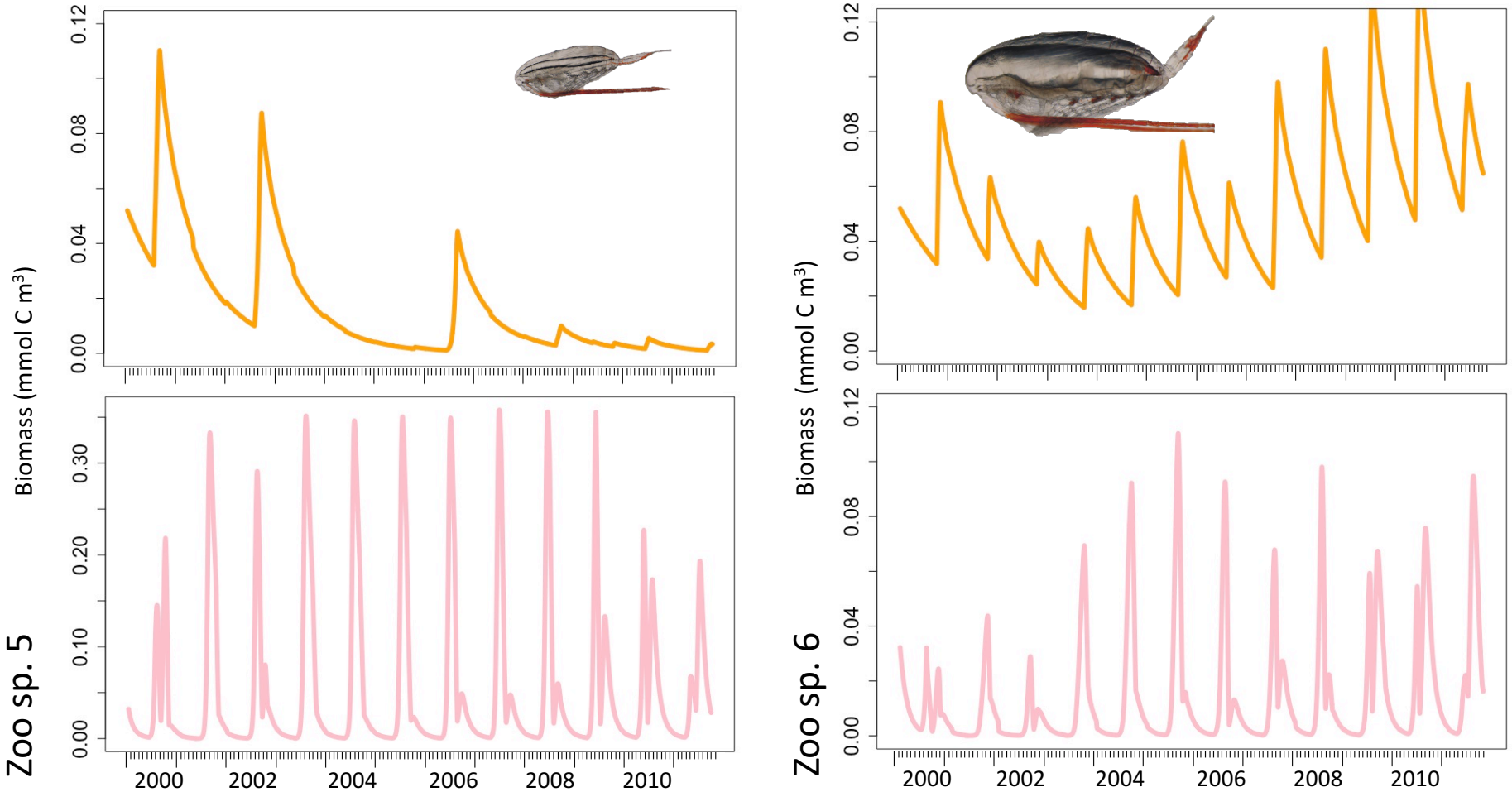
Entry and Exit of Diapause



In diapause

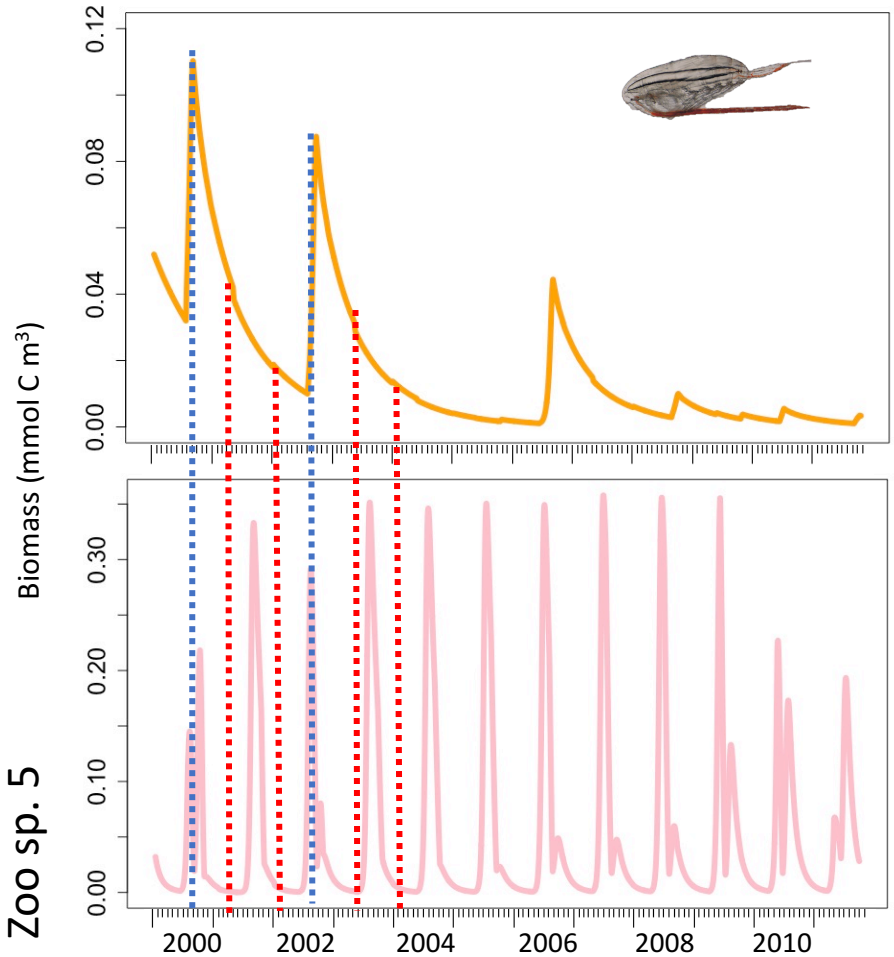
Active

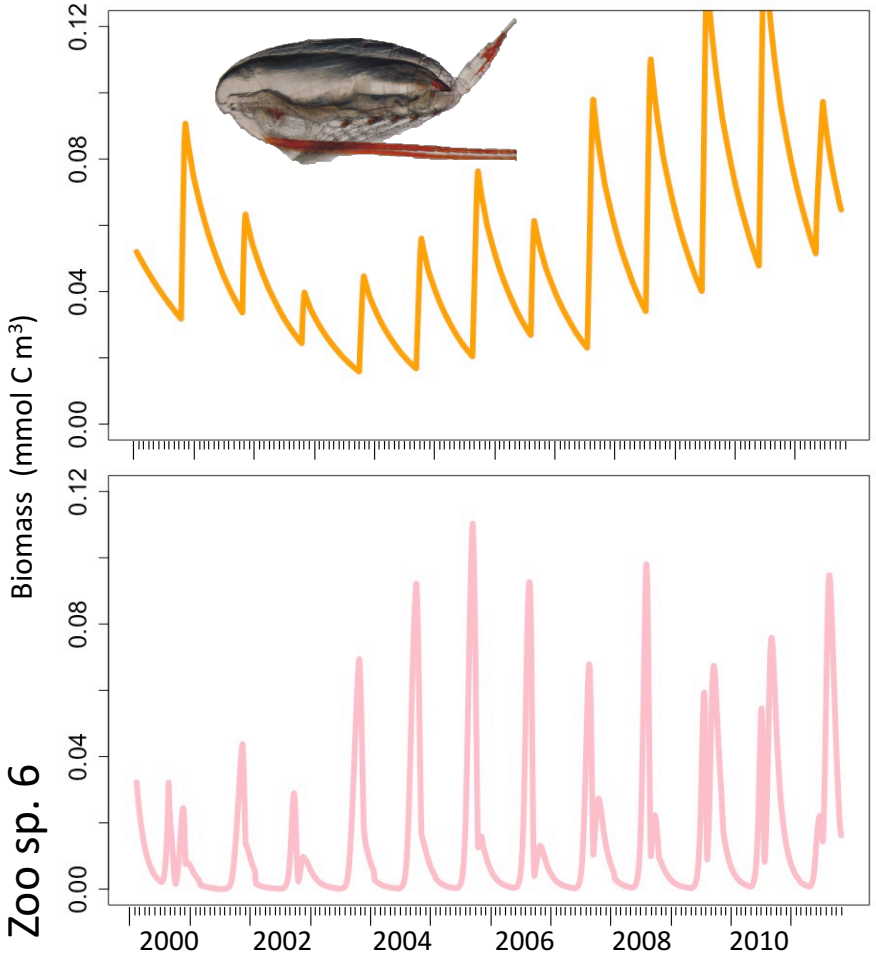
Diapause - Synchronism



Diapause - Synchronism

Unstable community

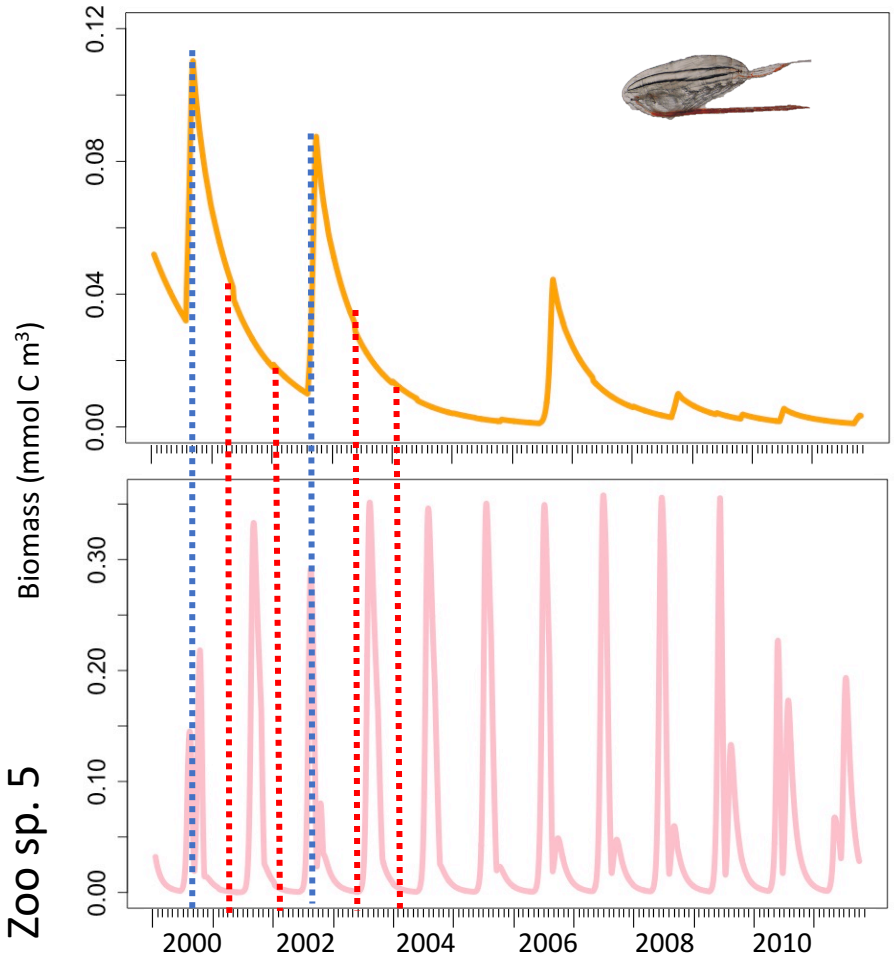




Not synchronised with prey

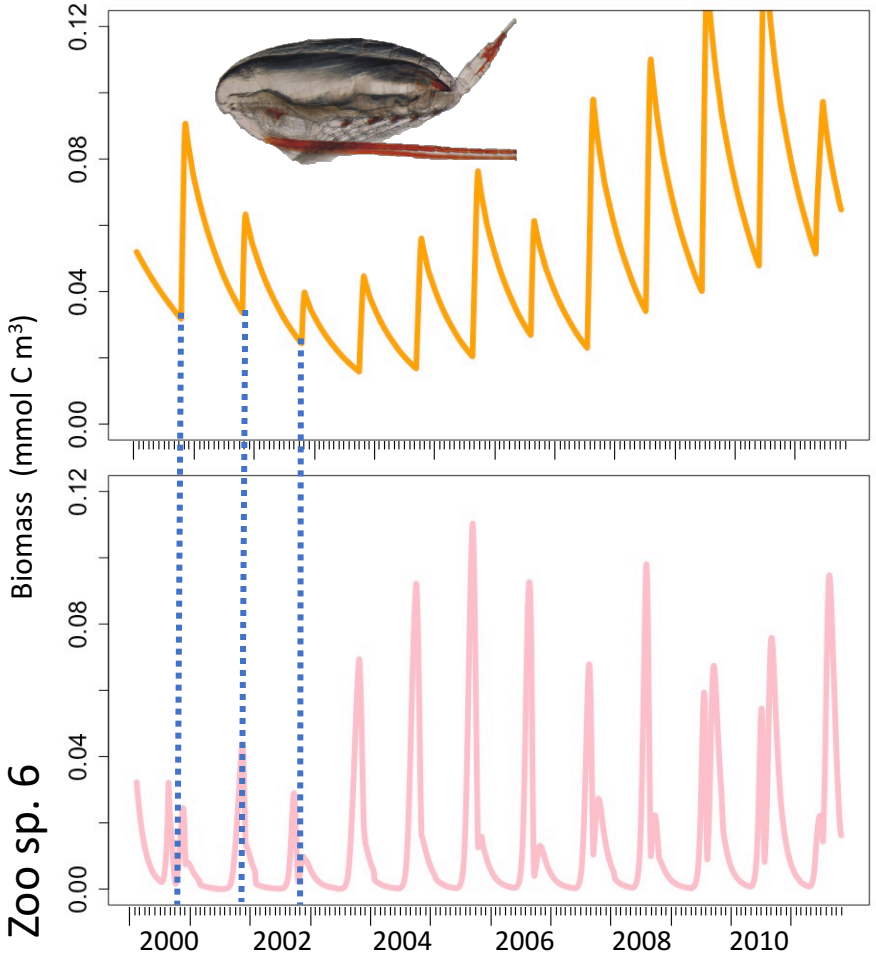
Diapause - Synchronism

Unstable community



Not synchronised with prey

Stable community



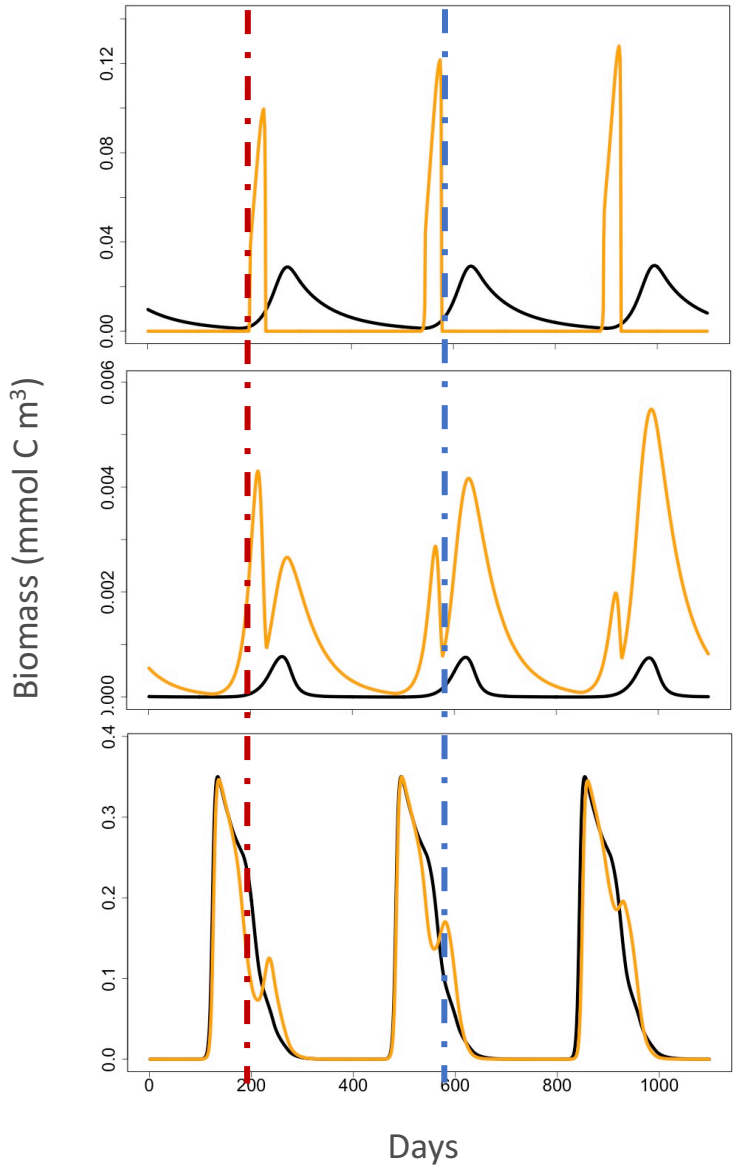
Synchronised with prey

Impact on the plankton communities

Metazoan

Zooplankton

Phytoplankton



Without diapause

With diapause

Exiting diapause

Entering into diapause

Conclusion

- Simple assumptions can represent complicated traits;

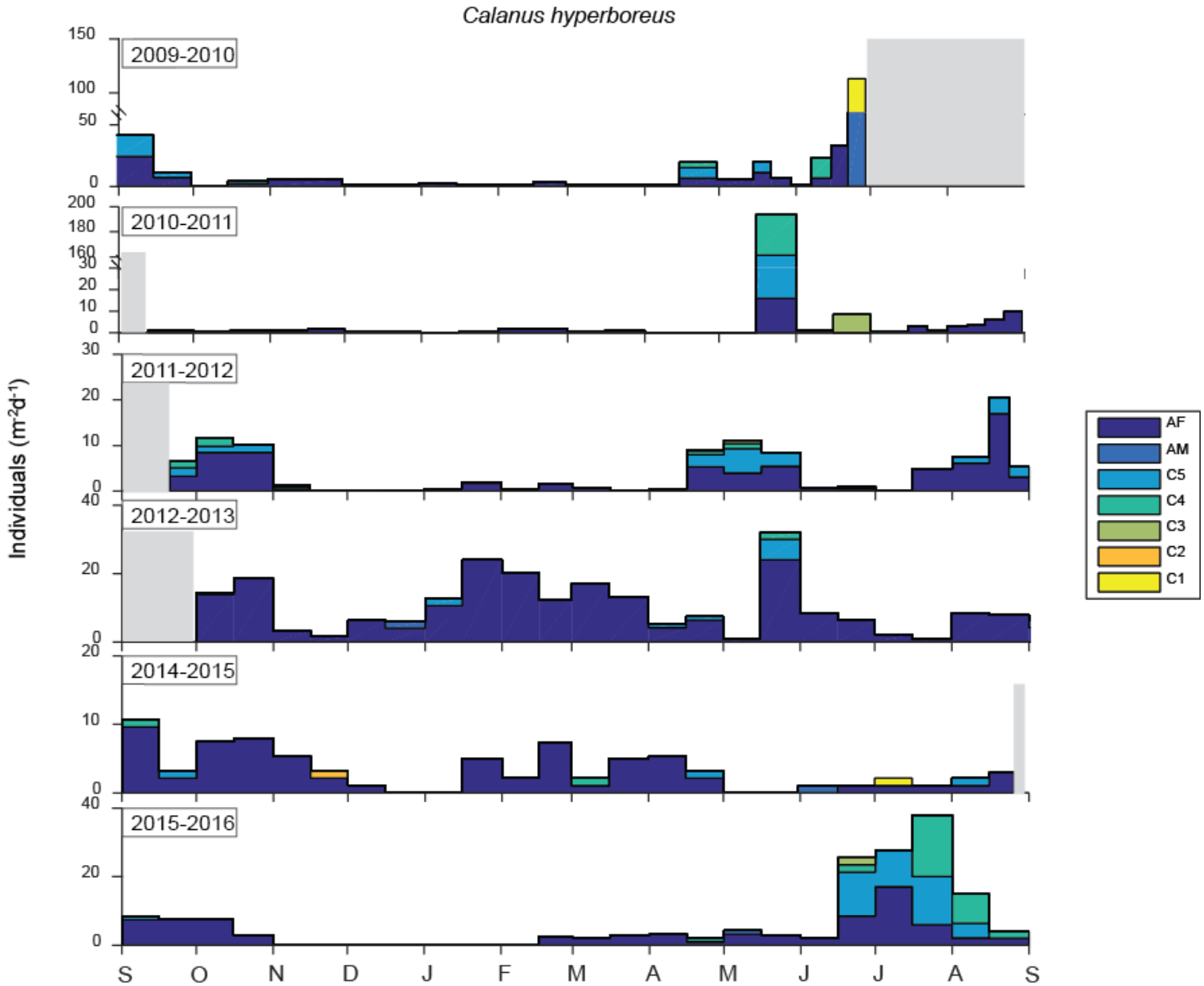
- Already have a strong significance in modelling a numerical pelagic arctic ecosystem

- This will have implications on:

- Biogeochemistry;
- The ontogenetic migration modeling;
- Future scenarios of environmental changes.

Questions ?

What is happening in real life



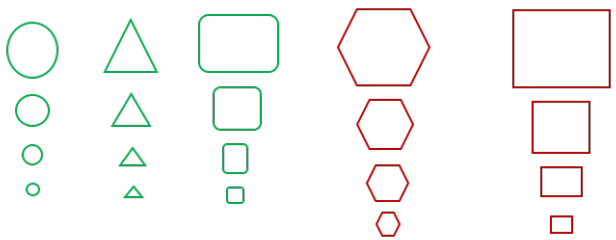
Duzetter et al. In Prep

Darwin – Emerging model

Biological model DARWIN

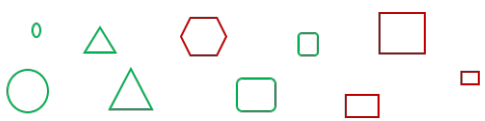
Divers functional groups

Phytoplankton Zooplankton



Divers size classes

Selection of the fittiest species to the numerical environment



Emerging community adapted to the physical model (environement)

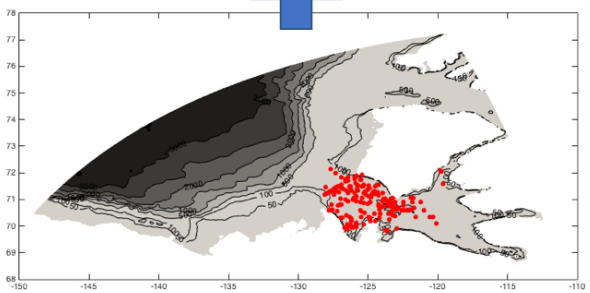
Physical model of local circulation

Temperature

Salinity

Photoperiod

Forcing



Source: Christiane Dufresne

Field data of nutrients