

# The role of *Phaeocystis* spp. in the Arctic Ocean Biological Carbon Pump

## Problem

- 1) Largest uncertainties in future projections of the biological carbon pump (BCP) by IPCC models are in the Arctic Ocean (AO)
- 2) Current biogeochemical models do not represent key processes governing the Arctic BCP
- 3) Here: Focus on phytoplankton community – especially the role of *Phaeocystis* spp.

## Why *Phaeocystis* spp.?

- *P. pouchetii* is a significant primary producer **spreading in the AO**
- Increasing dominance due to better **tolerance** towards acidification, higher temperature and irradiance, poorer nutrient conditions

## Methods

- Development of *Phaeocystis* spp. in REcoM3
- Implementation based on **literature** & 3D evaluation against **observations**:
  - Reassessment of temperature functions
  - Tuning of parameters for grazing, PI-curve, nutrient uptake, etc.
- Hindcast transient simulations (1970–2023)

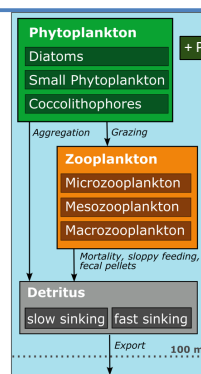
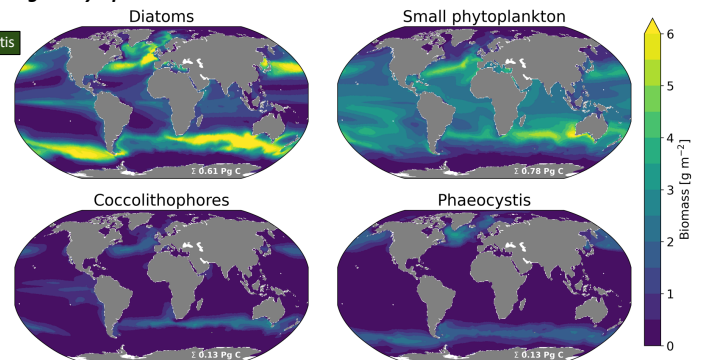


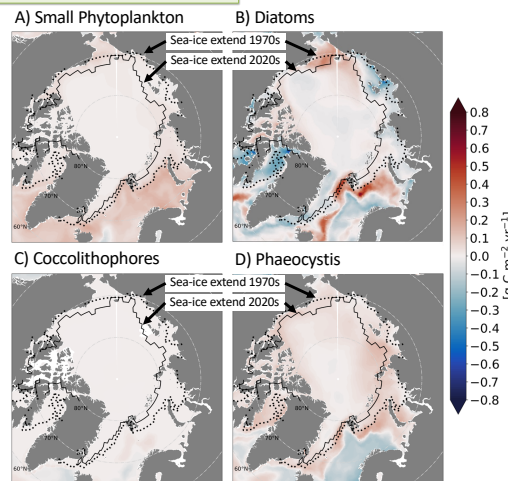
Fig 1: *Phytoplankton biomass.*



## Phytoplankton Community Shift

- less diatoms, more *P. pouchetii* & coccolithophores & other small phytoplankton
- especially strong where sea-ice retreats, i.e. regions of regime shift (light to nutrient limited system)

Fig. 2: *Absolute changes of NPP (1970 – 2023) and evaluation of the sea-ice extend.*

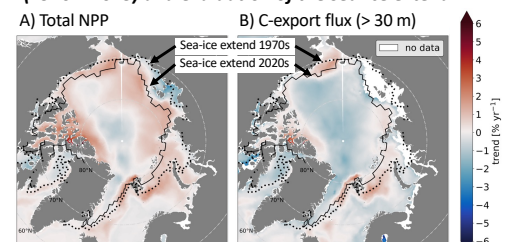


## Unexpected Feedback ?

**more NPP = less C-export flux**

- the shift to more *P. pouchetii* may be responsible for this, due to ...
- less ballasting compared to diatoms
- less grazing by large zooplankton
- lesser production of big particles

Fig. 3: *Relative changes of NPP (A) and C-export flux at 30 m (B) (1970 – 2023) and evaluation of the sea-ice extend.*



## Outlook

- Will *P. pouchetii* further increase in the future AO?
- How and where will *Phaeocystis* spp. impact the BCP (NPP, C-export and storage) in the future?
- Investigation of interaction with ballasting/aggregation material (TEP, cryogenic gypsum, sea-ice algae, lithogenic material, etc.)

### Abbreviations

AO – Arctic Ocean, BCP – biological carbon pump, C – carbon, FESOM – Finite Element Sea-Ice Ocean Model, IPCC – Intergovernmental Panel on Climate Change, NPP – net primary production, PI-curve – Photosynthesis-Irradiance curve, REcoM – Regulated Ecosystem Model, TEP – transparent exopolymer particles

### Observational References for Model Evaluation:

WOA – Nutrients, Oxygen  
GLODAP, SOCCAT – Carbonates & CO<sub>2</sub> fluxes  
MAREDAT – Planktonic Biomass  
Satellites: Lewis and Arrigo, OC-CCI – Biomass and NPP  
Mouw et al. 2016 – Export fluxes

### References

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