Drivers of algal blooms in the polar areas

The changing Arctic

Norway – Estonia webinar 14.4.2021

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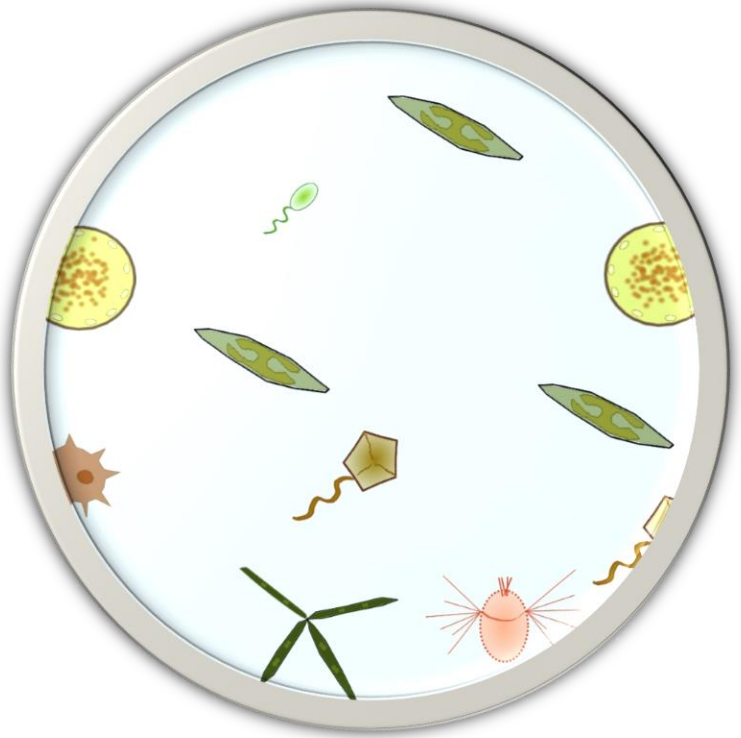


+ partner organizations

PI of the Arctic projects (biology): Philipp Assmy

PI of the Southern Ocean project (phytoplankton part): Sebastien Moreau

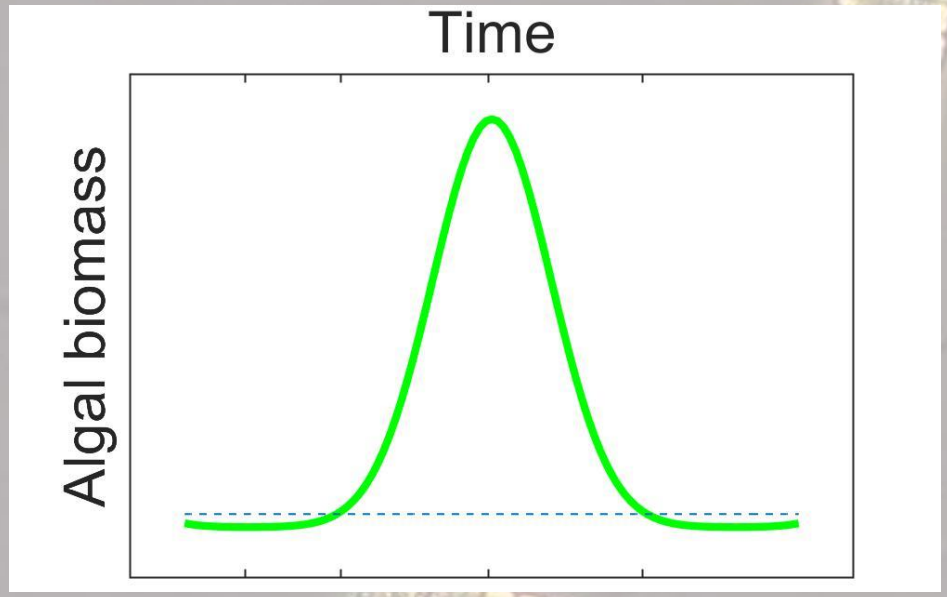
Introduction

Algae: «plants» of the aquatic environments
Phytoplankton and ice algae: microscopic algae in the water column and sea ice

Why are we interested in algae?

- Marine food webs rely on algae
- Relevance of photosynthesis in the carbon cycle
- -> understanding the ecosystem, also relevance for spatial planning of ecosystem management

Algal bloom

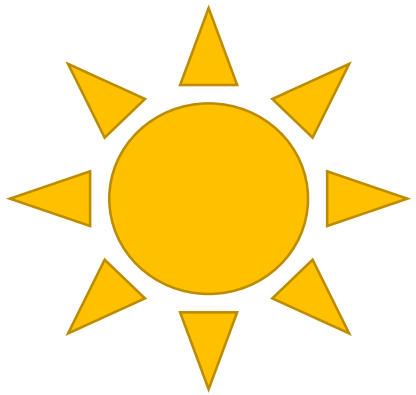


NB: Algae need sunlight and nutrients for photosynthesis
(= environmental drivers)

With the environmental changes in the polar areas, questions arise:

How do the algae in ice-covered waters respond to the increased light availability? Are growth or community composition affected by the increased light availability?

Are the algae able to protect themselves from excess light?

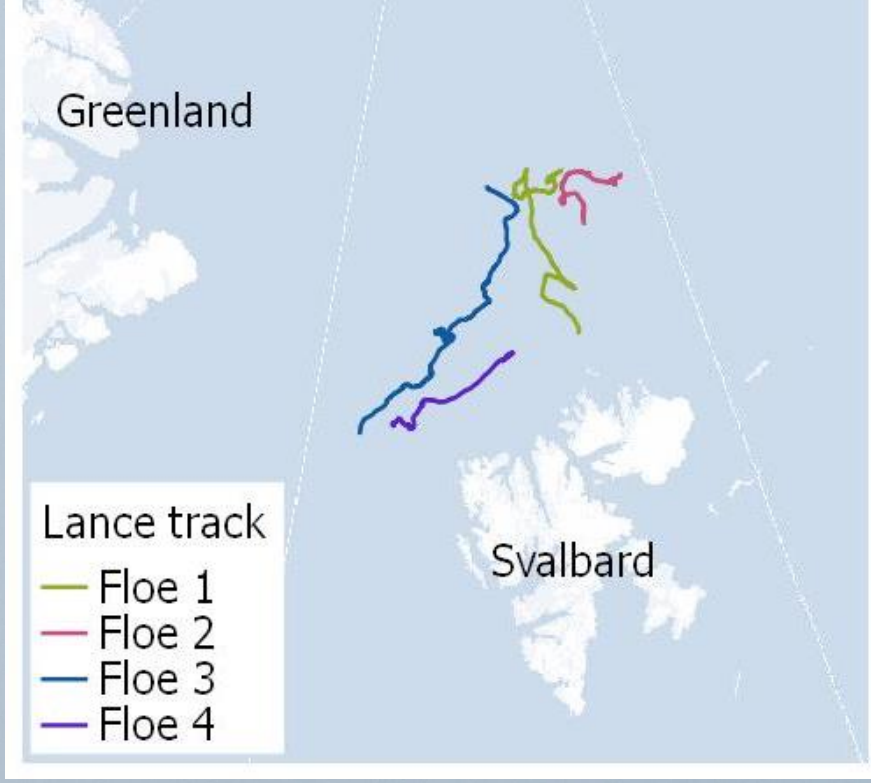


Introduction

The Arctic main project

N-ICE2015
NORWEGIAN YOUNG SEA ICE CRUISE

- 6-month long drift expedition in the pack ice region north of Svalbard (80–83.5 °N)
- Atmosphere, ice, ocean, ecosystem



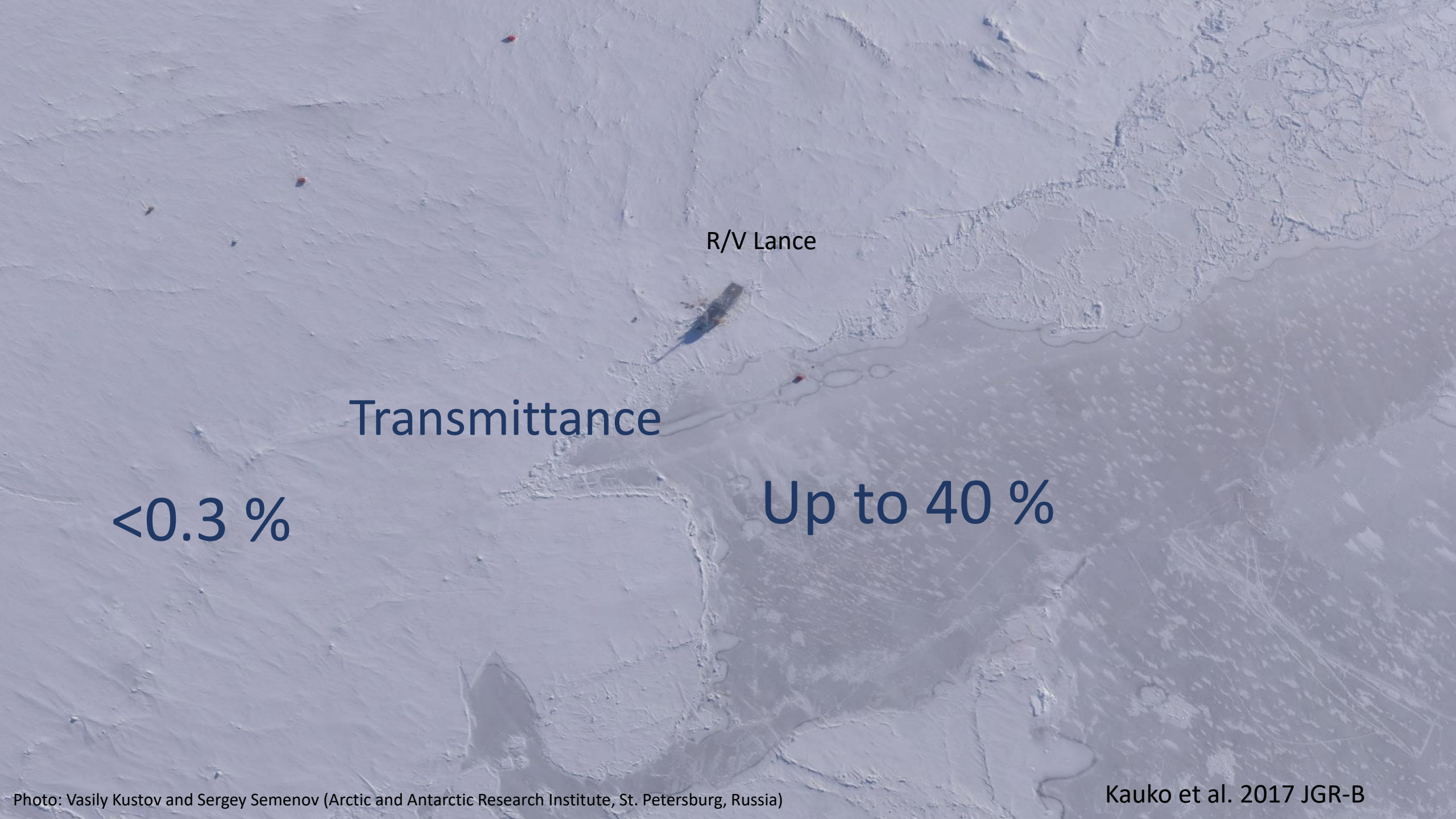
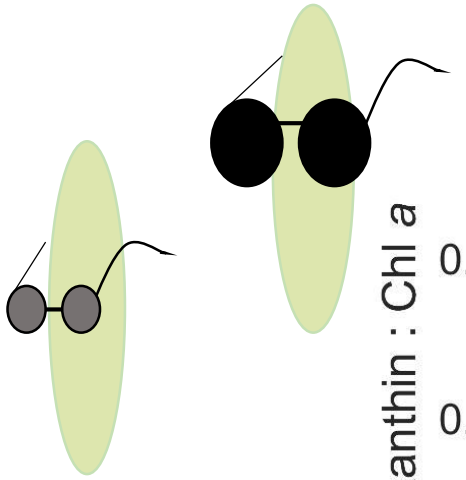


Photo: Vasily Kustov and Sergey Semenov (Arctic and Antarctic Research Institute, St. Petersburg, Russia)

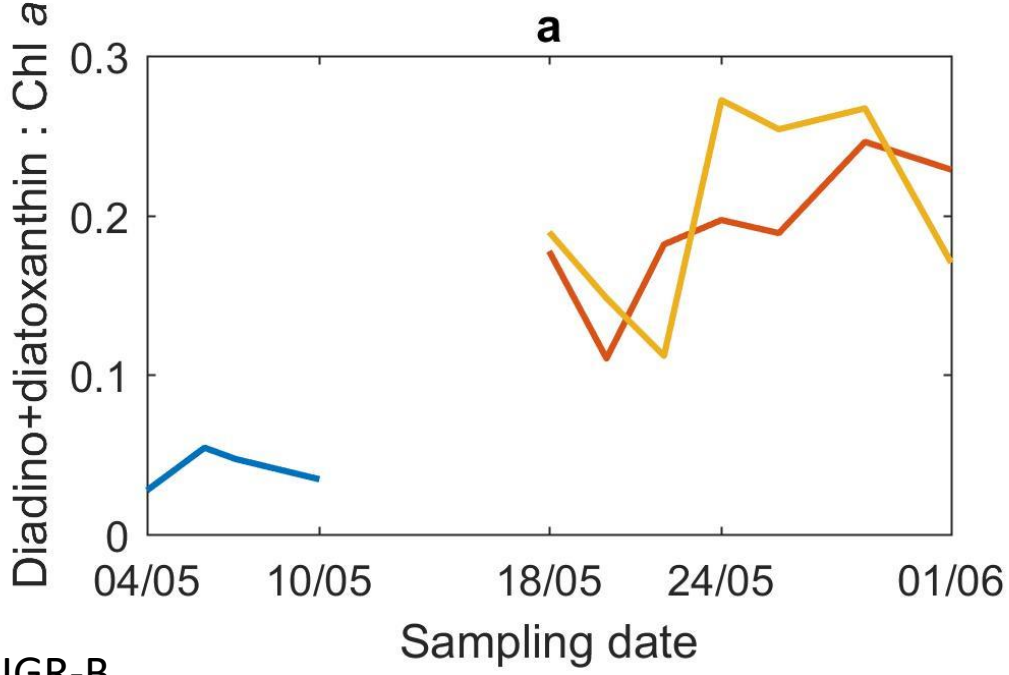
Kauko et al. 2017 JGR-B

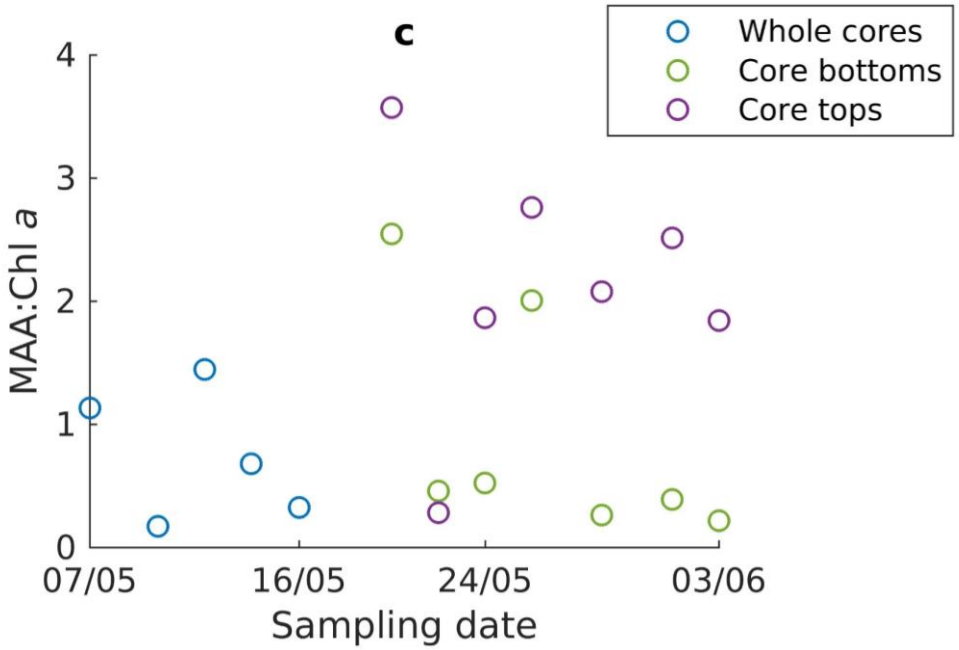
Results

1. In the thin sea ice, photoprotective carotenoids and MAAs increase in Spring



-> high photoprotection needed



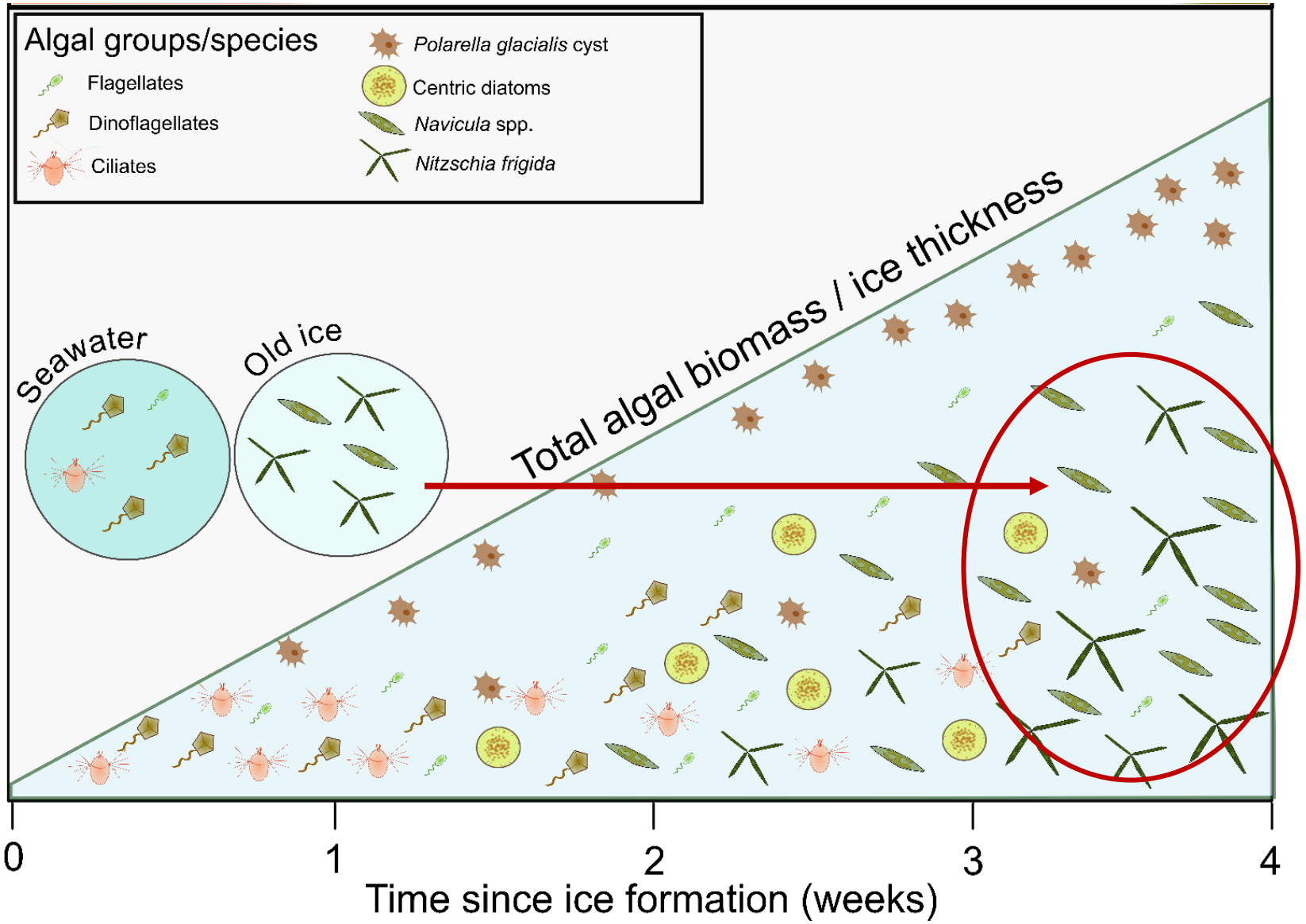


Kauko et al. 2017 JGR-B

Kauko et al. 2018 Front Mar Sci

Results

2. Species succession towards ice specialists

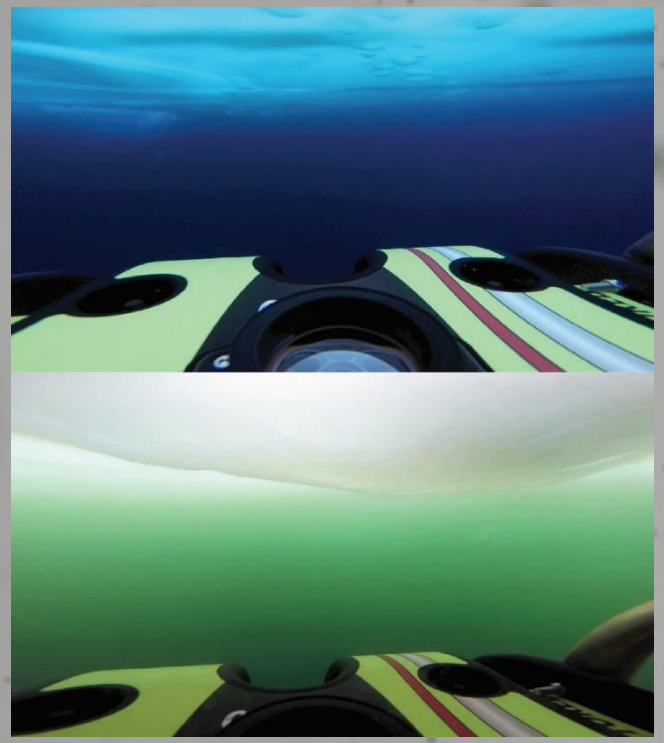


- Pennate diatoms dominated at the end of sampling in high irradiance conditions (up to 350 µmol photons m^{-2} s^{-1})
- Old ice functions as a seed repository (see also Olsen et al. 2017)
- Implications of loss of older ice?

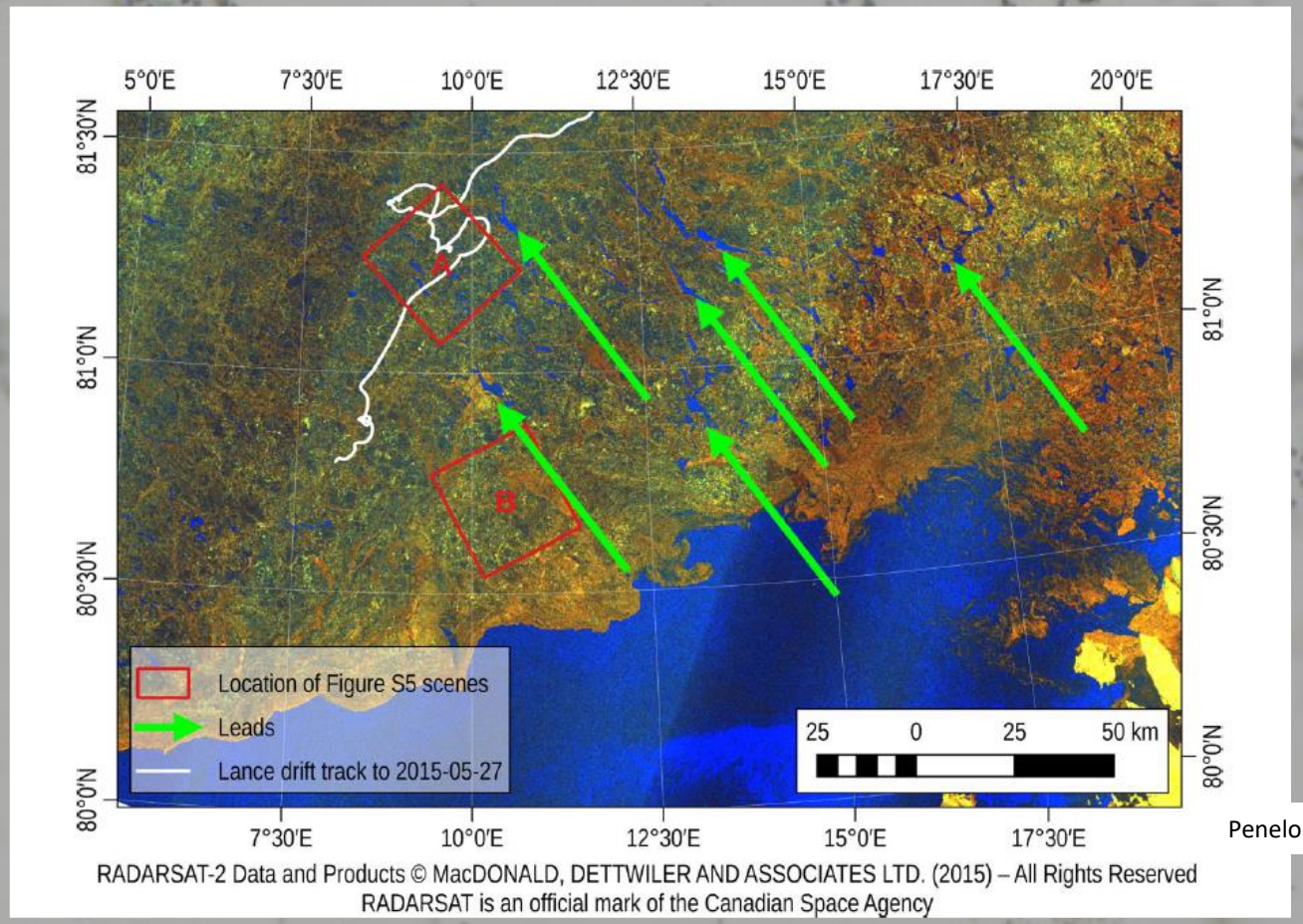
Kauko et al. 2018 Front Mar Sci

Results

Algal bloom also in the water column below the ice



CJ Mundy



Penelope M. Wagner

200 µm

Assmy et al. 2017, *Scientific Reports*

Google Earth

Southern Ocean Ecosystem cruise 2019
NPI + partners

Robin Hjertenes

Øystein Kjelsvik

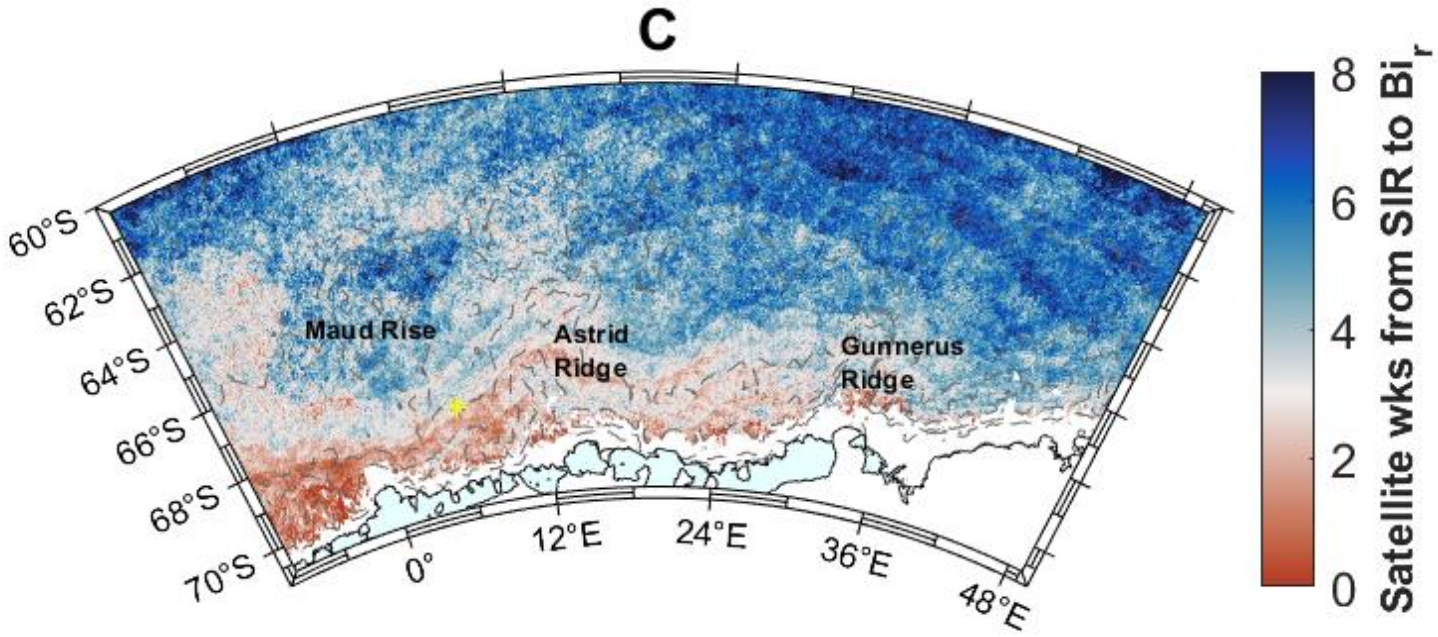
Results

Phytoplankton bloom phenology (*when*) in the Southern Ocean

Especially along the coast the blooms start within 3 weeks from sea ice retreat

-> sea ice, via e.g. light limitation, is concluded to control bloom initiation in those areas

Implications of a shorter sea ice period?



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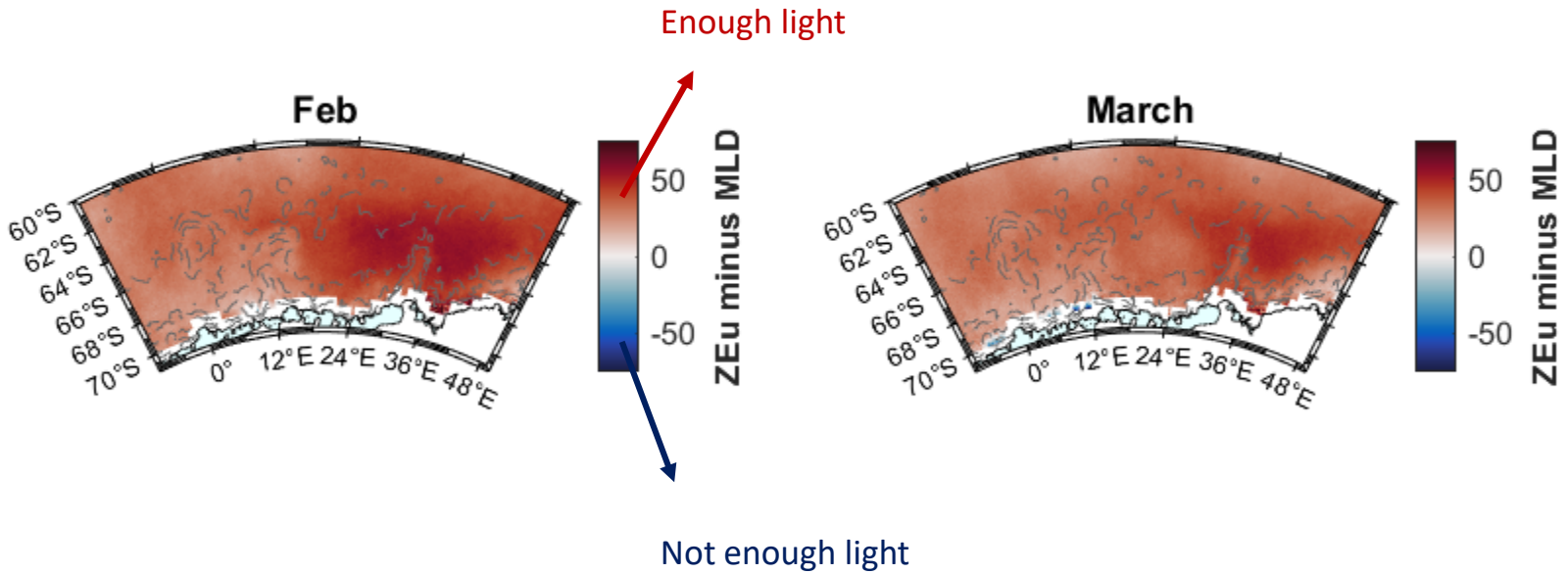
For bloom end, light is not the problem

At least not alone

Mixed layer depth (MLD) is shallower than euphotic depth (ZEu)



Grazing?

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Summary: light as a polar algal bloom driver

- Ice algal community succession in the young ice led to typical pennate diatom dominance (in the peak bloom phase), was not [illegible] by the light environment, and showed high invest[illegible] on
- Biomass in th[illegible] the high[illegible] ice despite
- A phytopl[illegible] bloom could grow beneath thick snow and ice cover because of high lead fraction providing light
- In Kong Håkon VII Hav (SO), light availability may limit the bloom start but not the end

Knowledge on algal responses to light availability is valuable in the times of rapid environmental change that affects the light conditions in the polar areas

THANK YOU FOR YOUR ATTENTION

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