

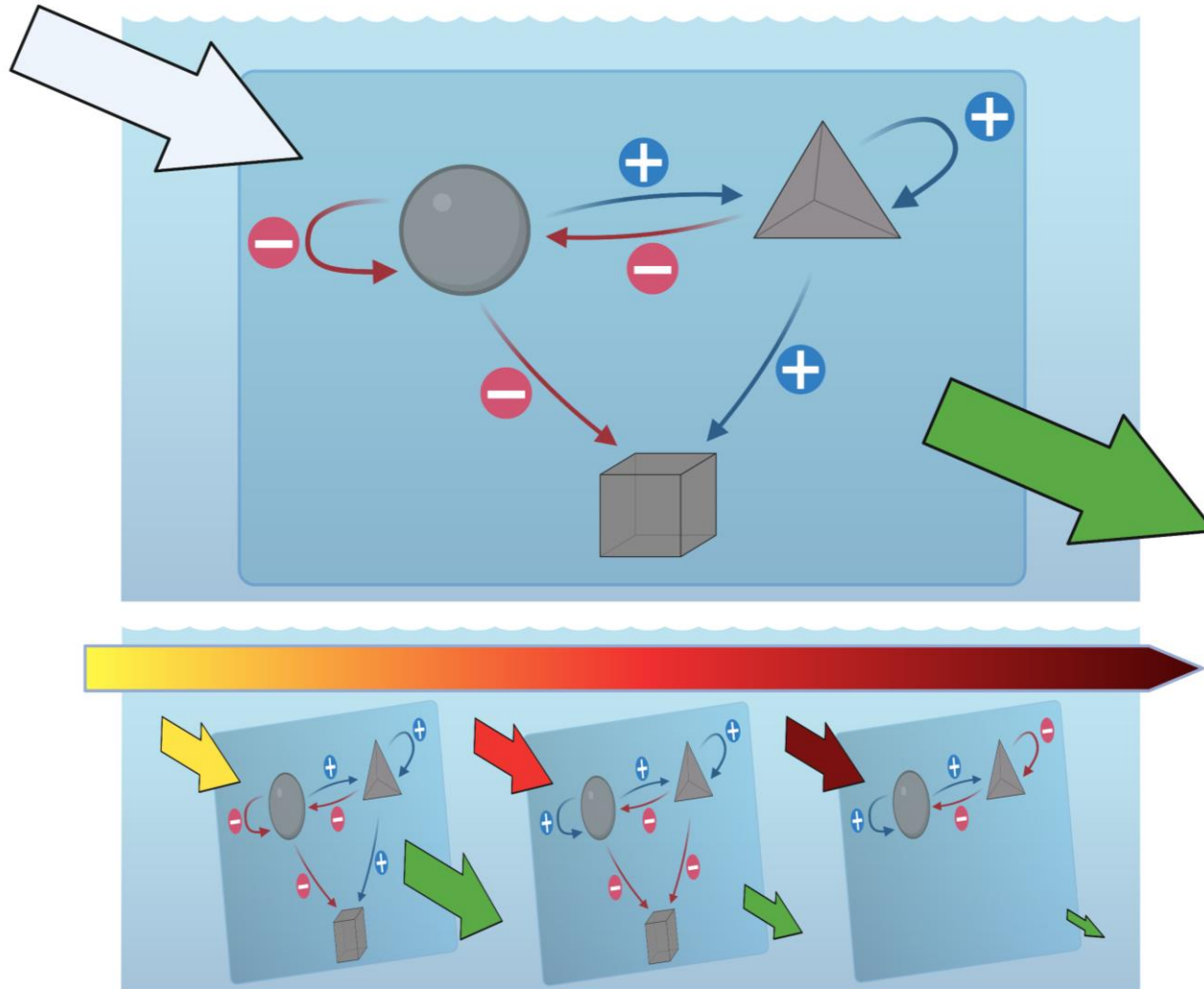
PoF IV Subtopic 6.2

Complementary studies assessing phytoplankton responses to climate change – from single organisms to community dynamics

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Topic 6: Ecosystem dynamics driven by species interactions



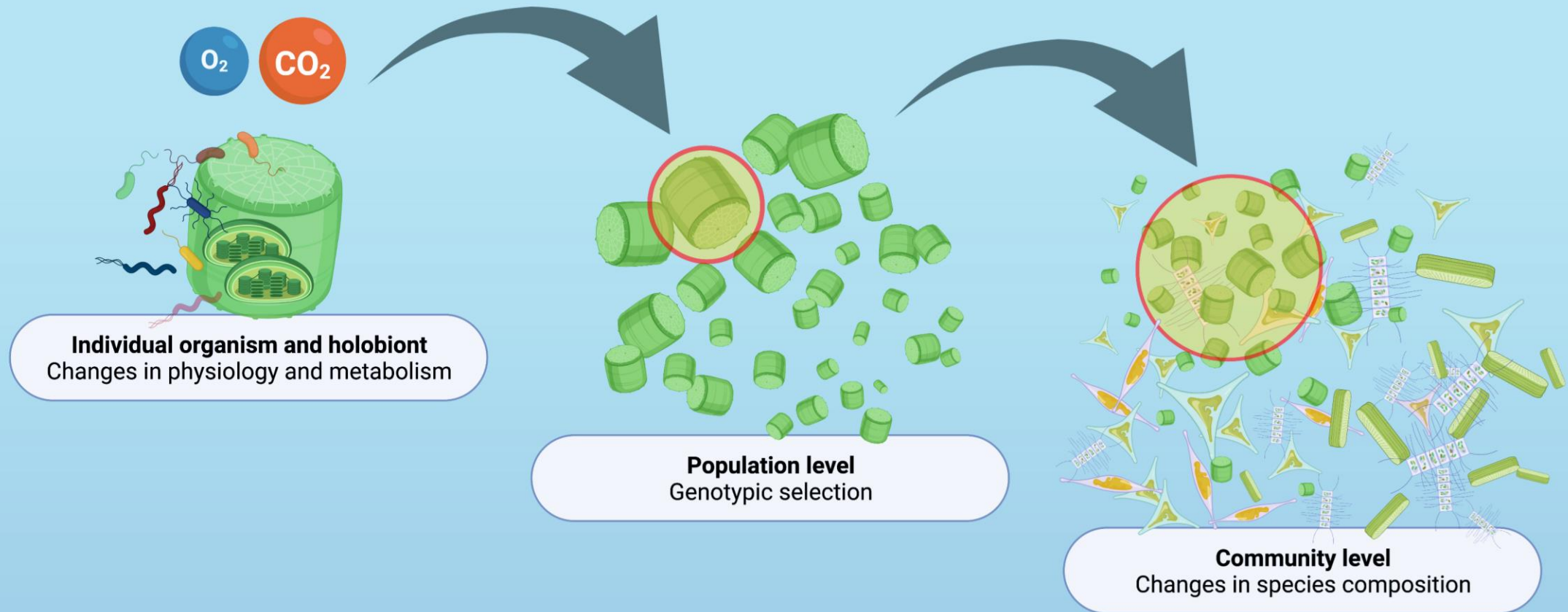
Overarching question:

How will biodiversity as well as corresponding ecosystem functions and services change?

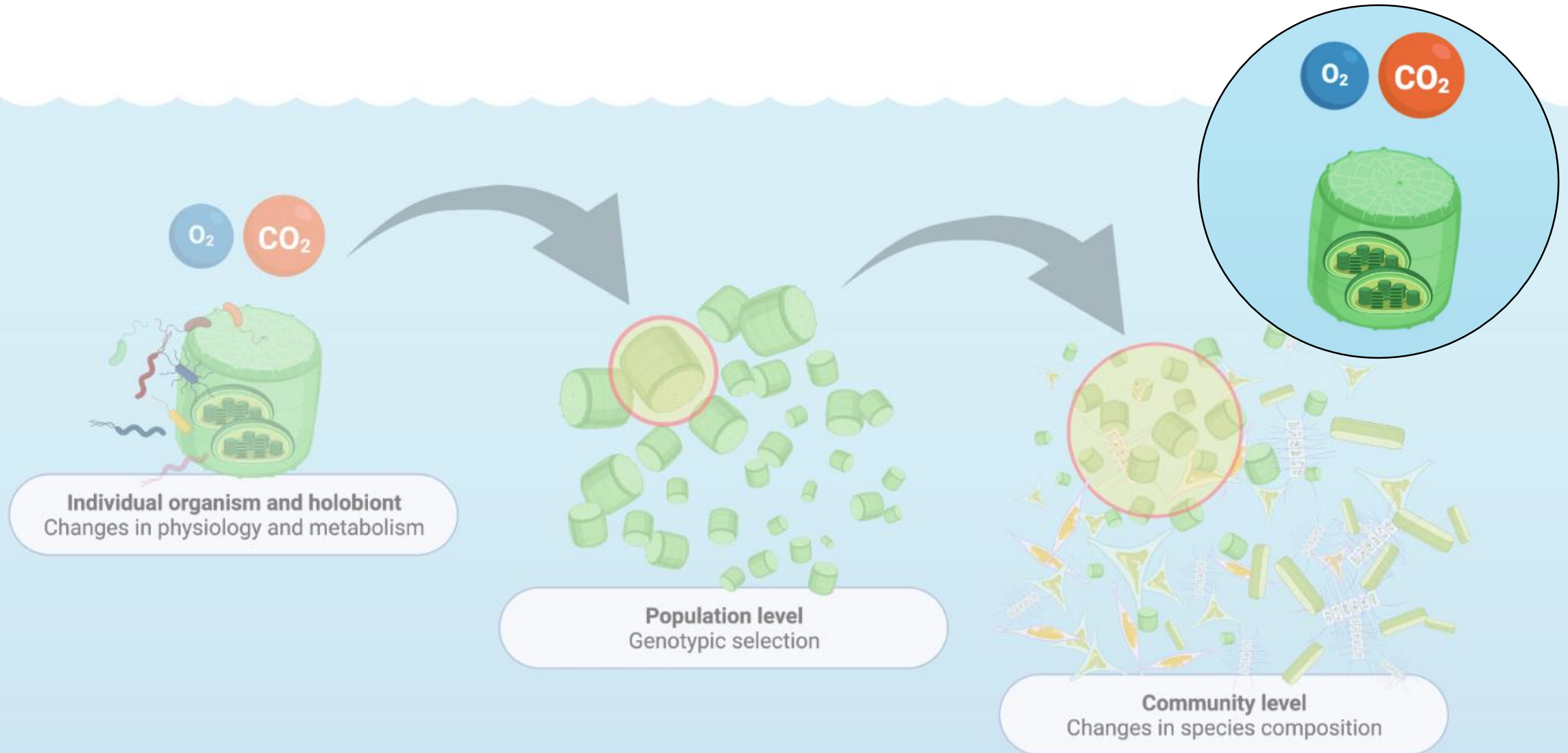
Main focus:

Phytoplankton, in particular diatoms → important spring bloom formers (most productive season in polar and temperate regions)

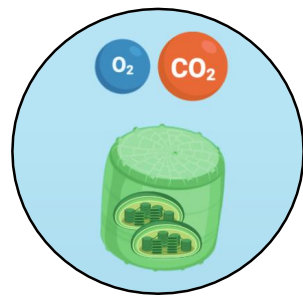
Different scales of adaptation on which changes can manifest



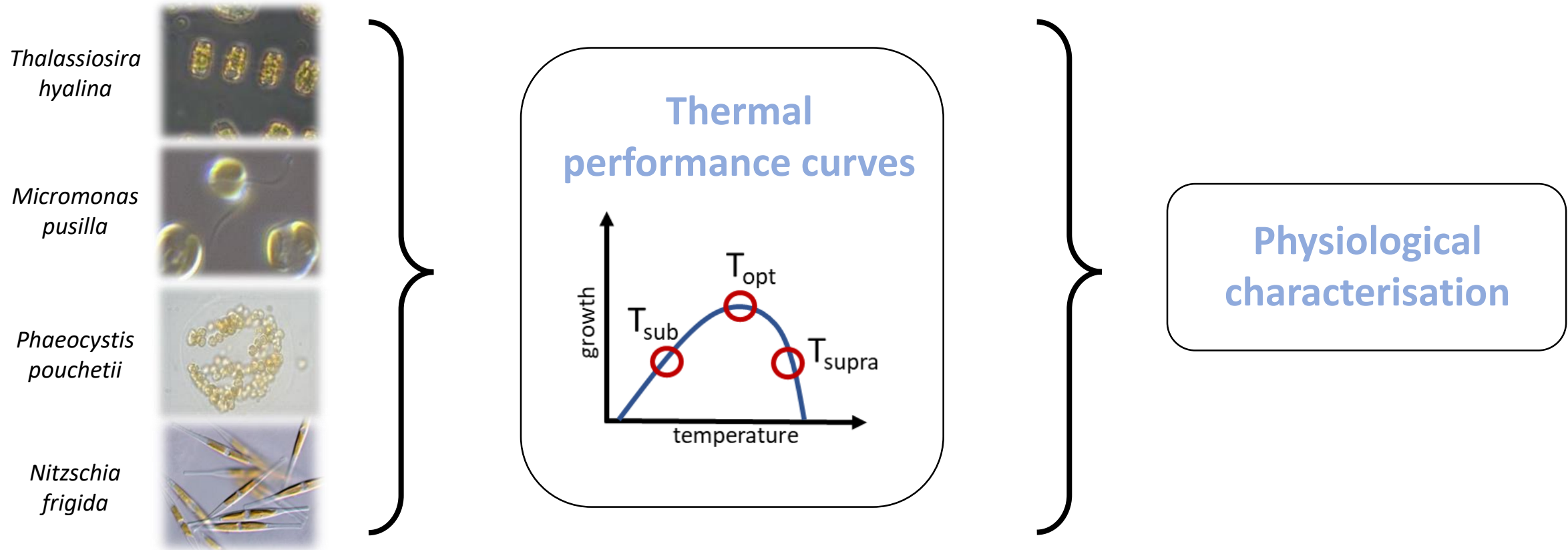
Physiological changes: capacities and limits



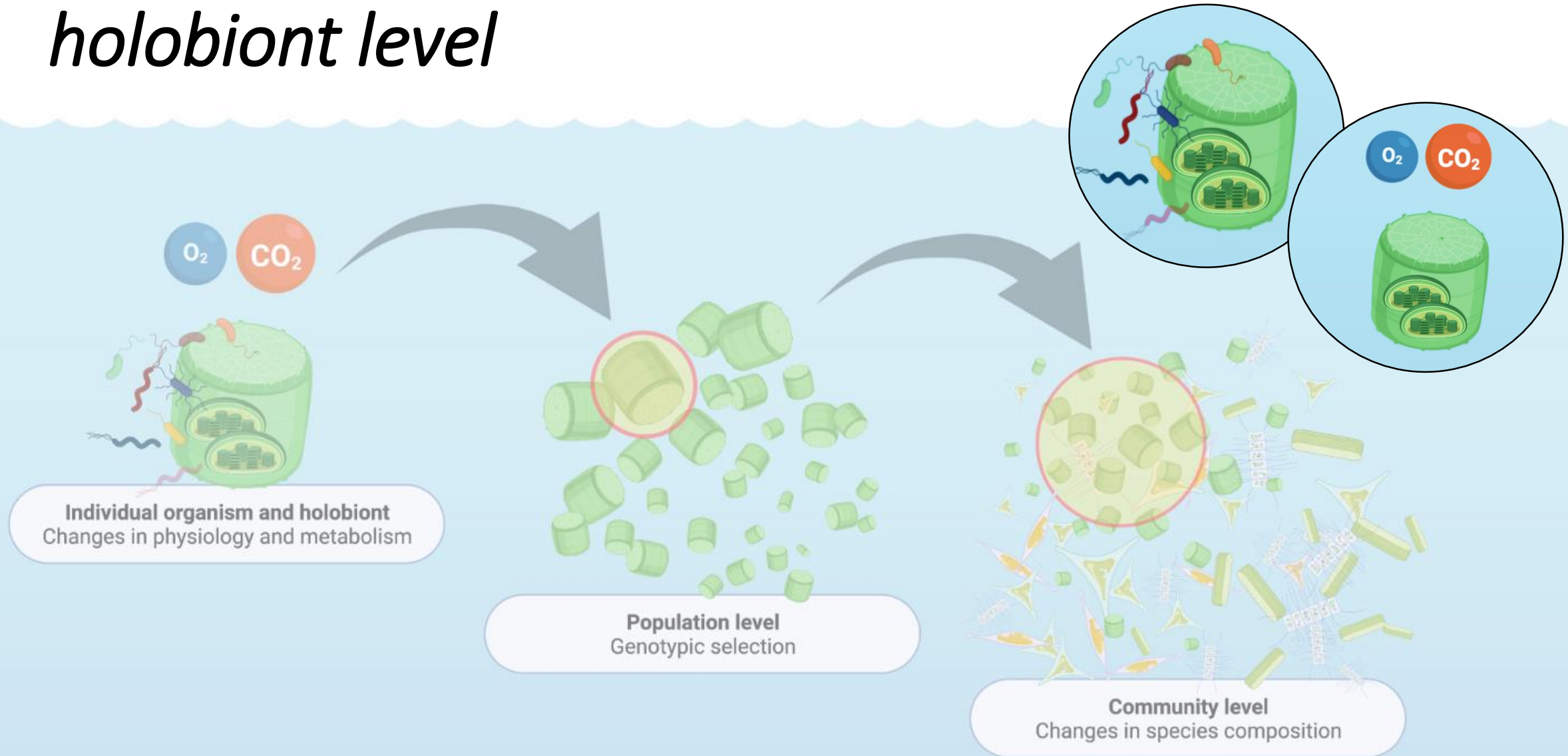
Physiological temperature responses of Arctic key phytoplankton species



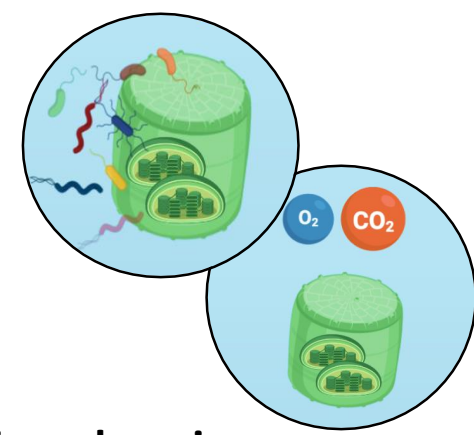
How does temperature mechanistically affect photosynthetic and respiratory sub-processes in single phytoplankton cells?



Physiological changes: consequences on the holobiont level

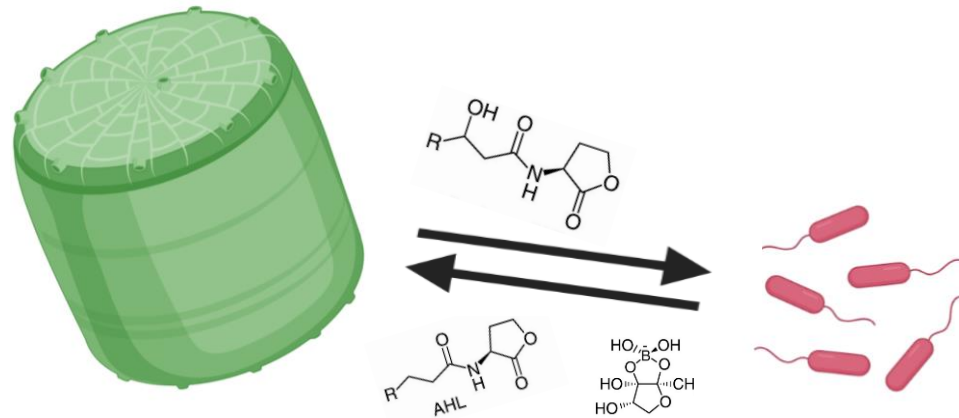


Consequences on the holobiont level



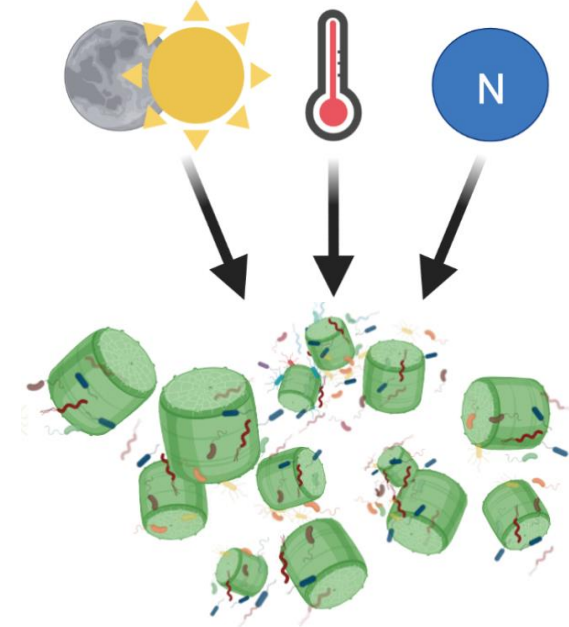
“Recognition, signalling, and response of the Antarctic diatom *Fragilariopsis* to epibiotic bacterial colonisation”

- PhD project Marrit Jacob...



...assessing the chemical crosstalk between diatom host and associated bacteria

“The phytoplankton holobiont in a changing Arctic Ocean” - PhD project Jakob Giesler...



...investigating the net effect of diatom microbiome on host performance and adaptive capabilities

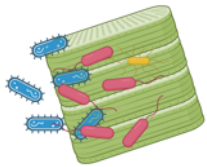
Holobiont project #1 (DFG)

Isolation of bacteria and preparation of axenic *Fragilariopsis* sp.

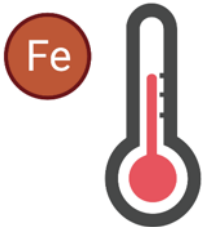


Co-culture assays

1. axenic host with single bacterial strains

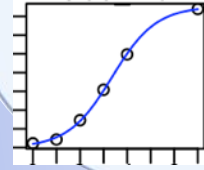


2. Artificial holobionts

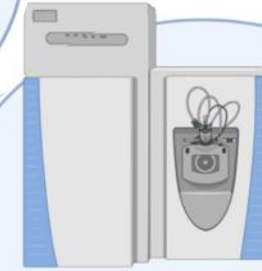


3. Shifts in temperature and iron availability

Productivity and photosynthetic activity



Productivity & fitness?



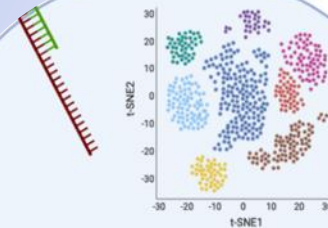
Exo- and endo-metabolome

Chemical communication?

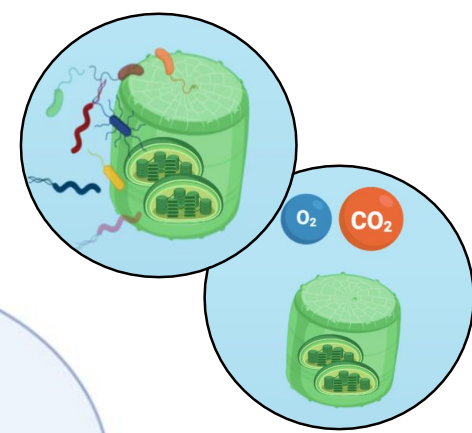


“Topography” of the interaction

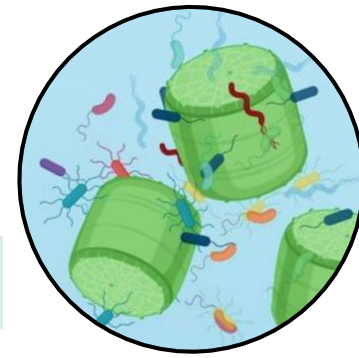
Environmental change?



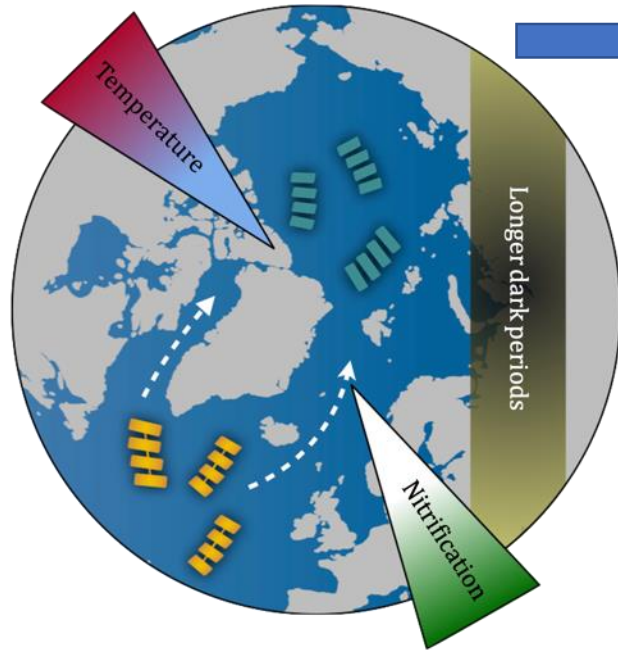
Transcriptome



Holobiont project #2

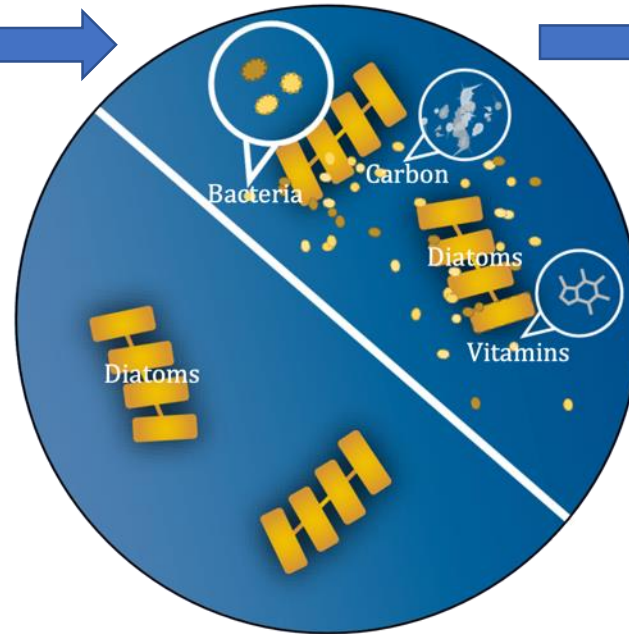


Exp. 1: Single driver reaction norms



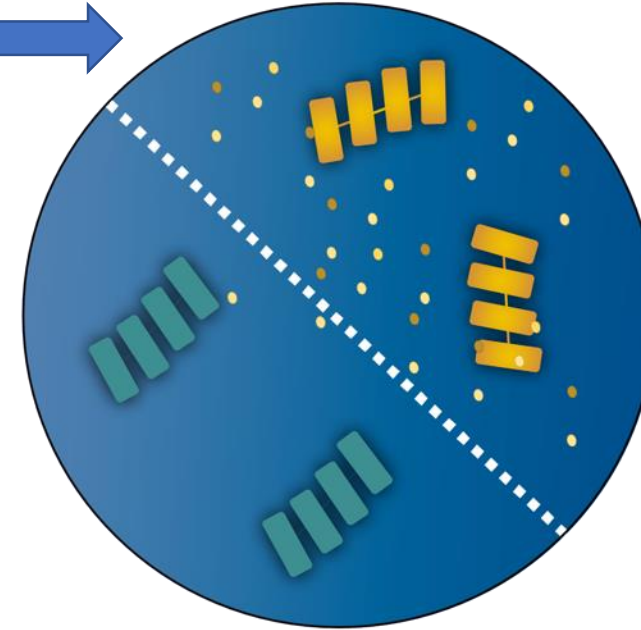
Aim: Determine reaction norms of xenic temperate and Arctic *Thalassiosira* species

Exp. 2: Decoupling of the holobiome



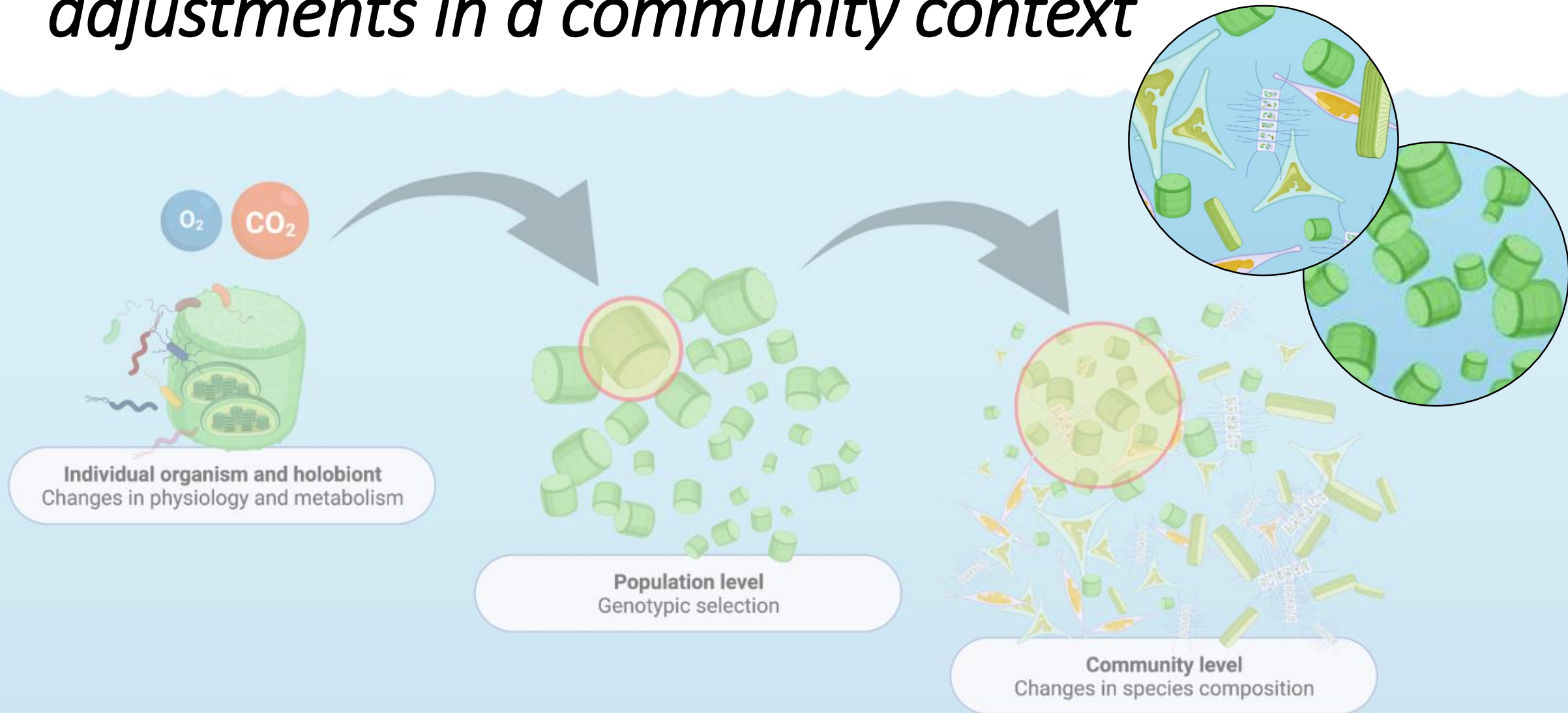
Aim: Decouple phenotypic plasticity from holobiome effect by comparing xenic vs. axenic cultures

Exp. 3: Common garden experiment

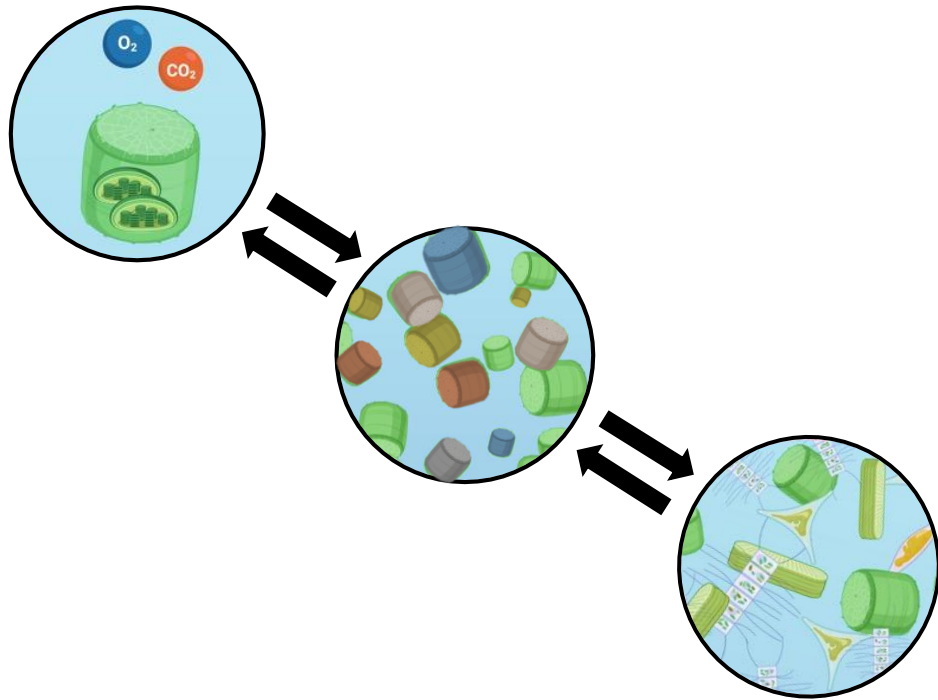
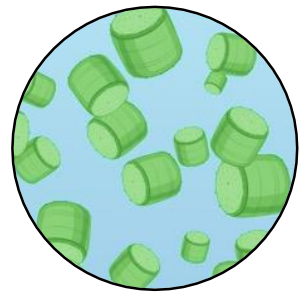


Aim: Mimicking the encounter of endemic and invasive diatom species (under multiple drivers)

Limits and consequences of physiological adjustments in a community context



Adaptive mechanisms in phytoplankton community and population dynamics under Arctic heatwaves

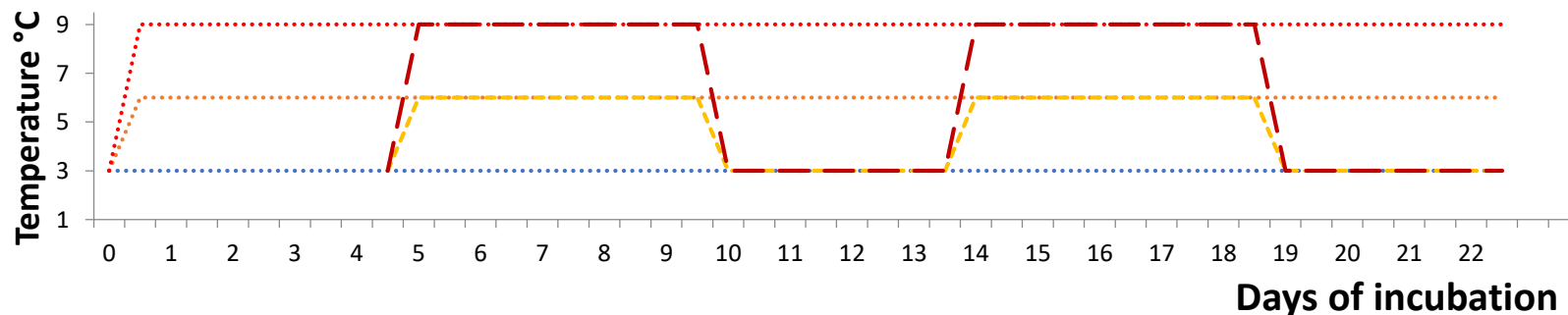


How do phytoplankton communities respond to dynamic and repeated heat events?

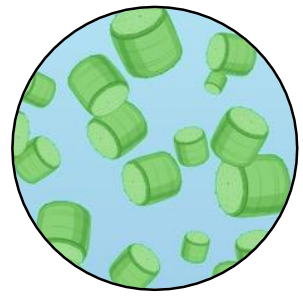
When are tipping points breached in community structure, diversity and physiology?

Disentangling ecological levels of adaptation through parallel Heatwave experiments:

- physiological plasticity vs.
- selection within species vs.
- selection between species



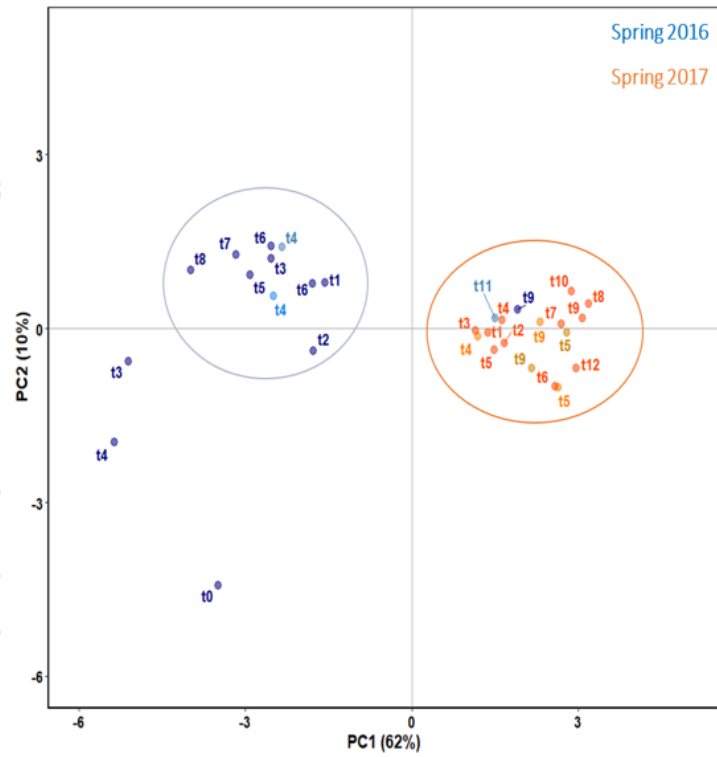
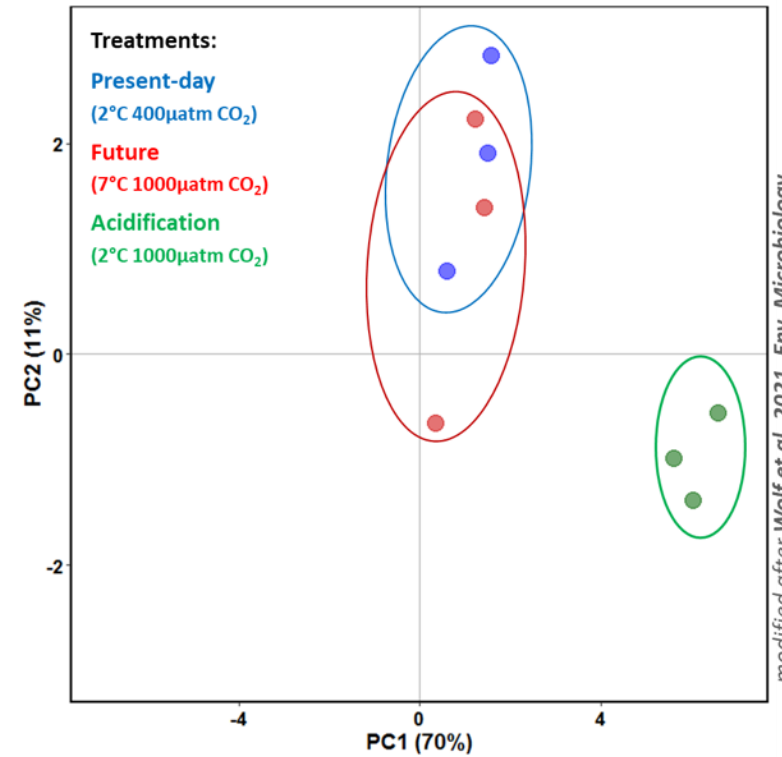
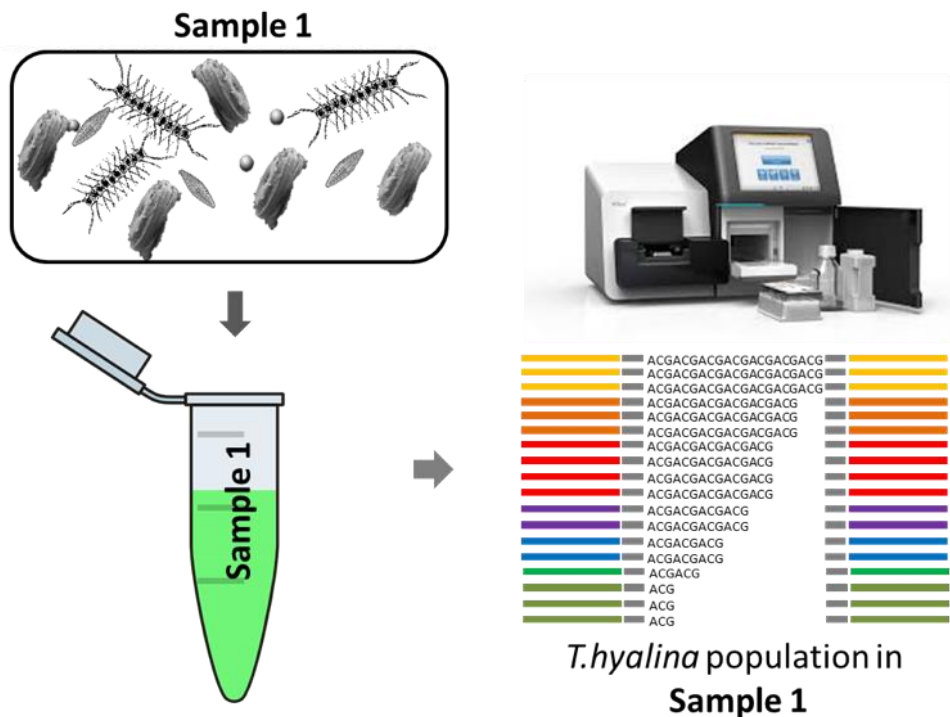
Microsatellite PoolSeq Barcoding (MPB): A novel method for resolving genotype selection



Efficiently resolving intraspecific population composition in diverse communities e.g...

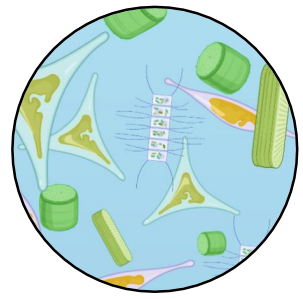
... in experiments

... in field samples

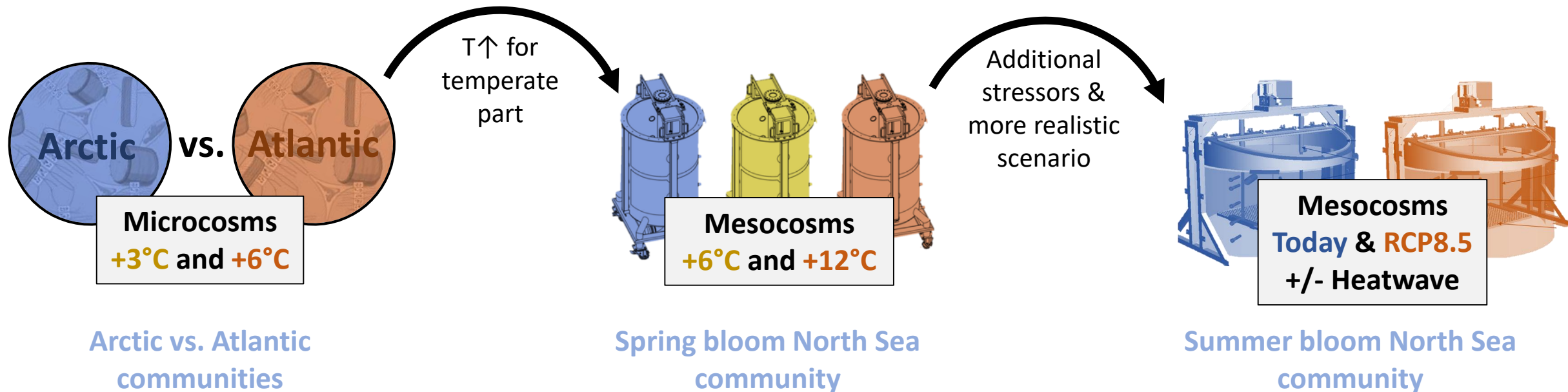


... and resolving dynamics within species at high temporal or spatial resolution.

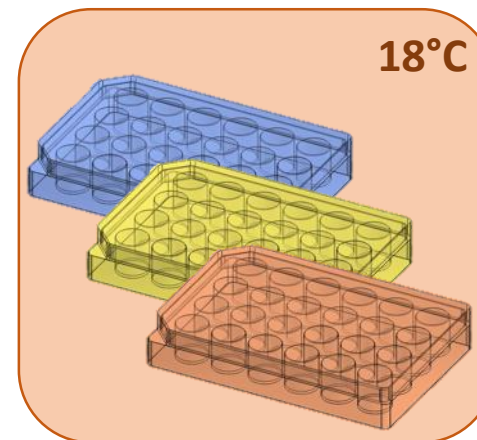
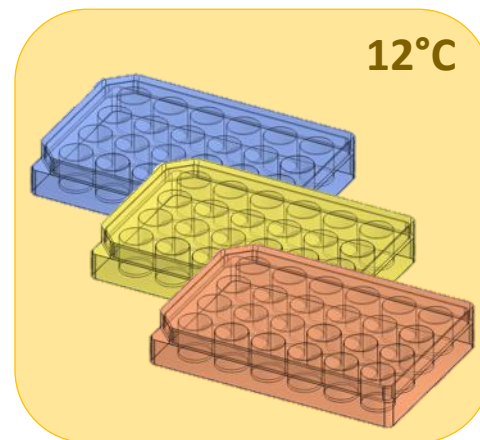
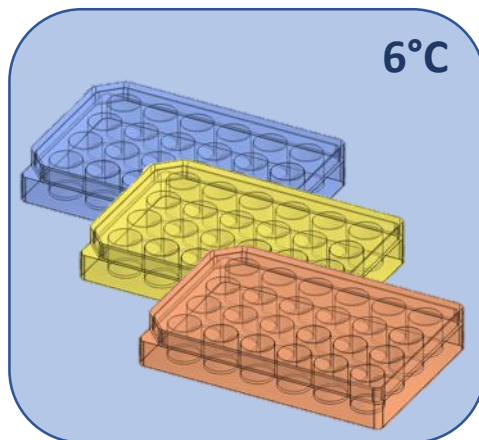
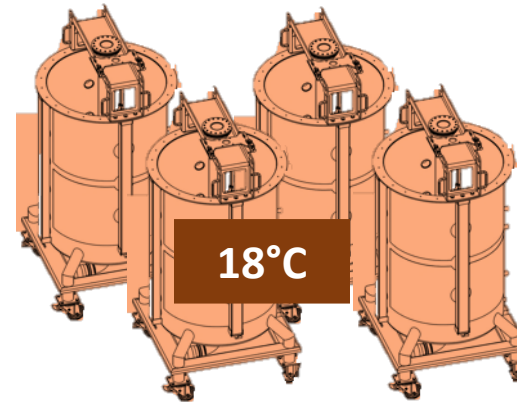
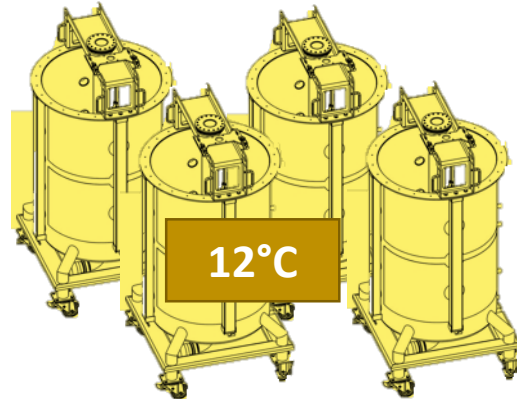
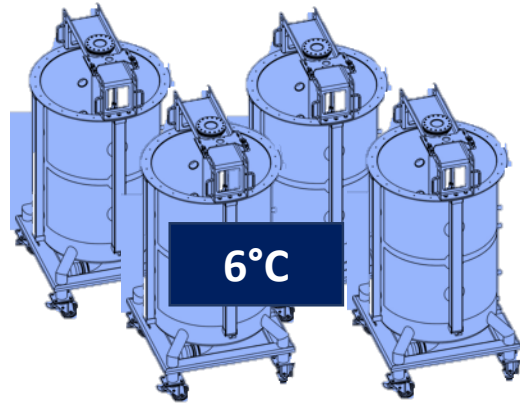
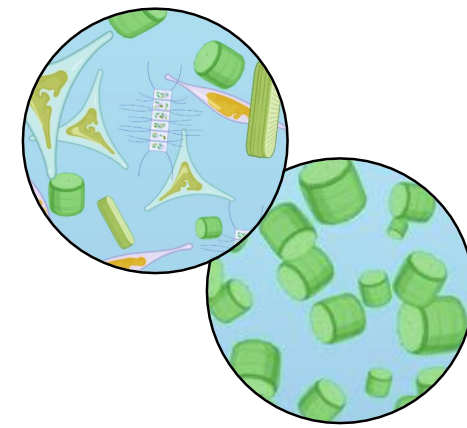
Investigating the effects of climate change on natural phytoplankton communities in micro- and mesocosms



How will future Arctic and North Sea micro-plankton communities be composed and what does this mean for the ecosystem?

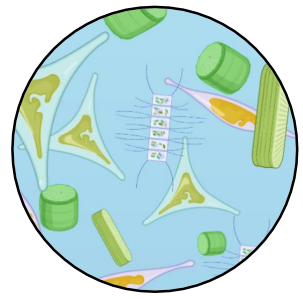


Population dynamics within a community setting – combining mesocosms with strain experiments



Isolation and cultivation of single *Thalassiosira* sp. strains from each mesocosm at different timepoints & incubation in common garden experiment

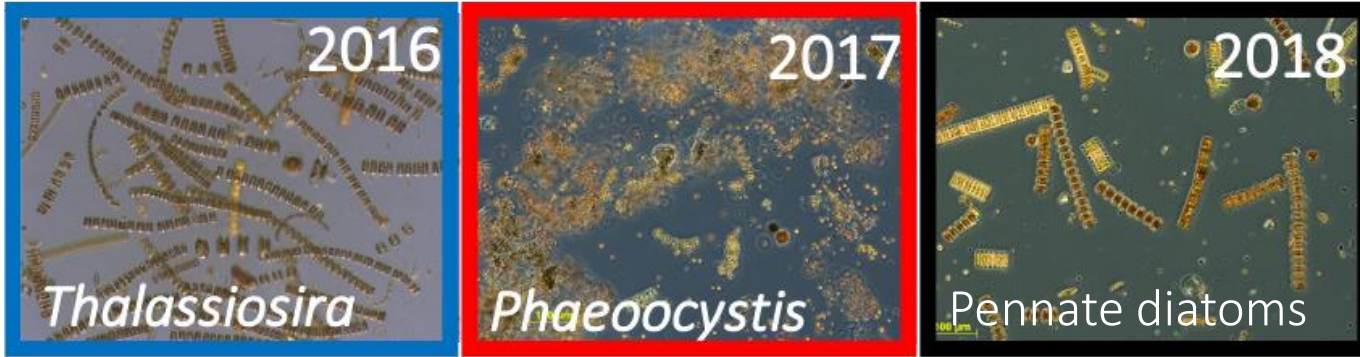
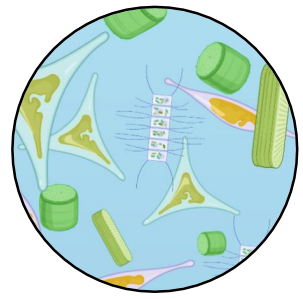
Kongsfjorden Spring bloom monitoring (AWIPEV)



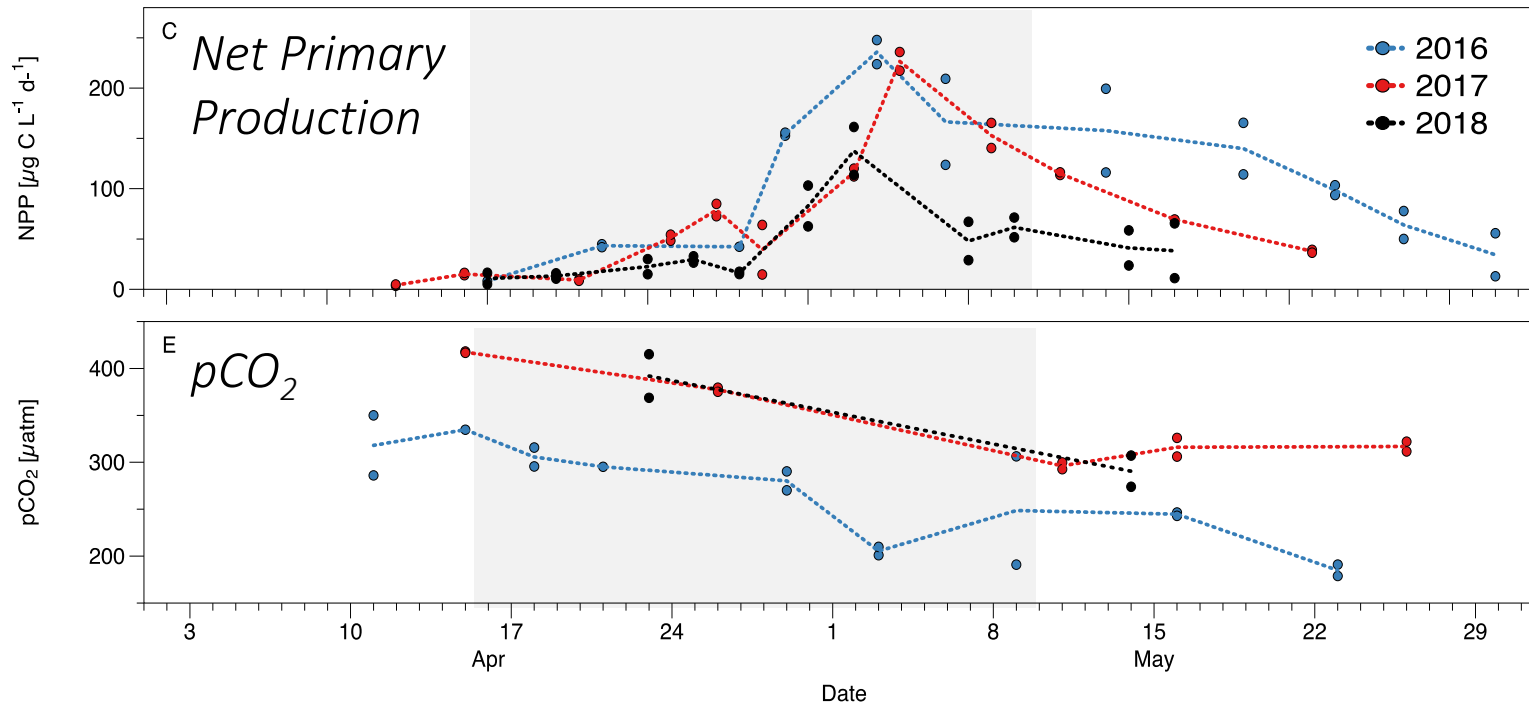
Sorting within and between populations → changes in species dominance

- What are the environmental and ecological controls of bloom composition (e.g. *Thalassiosira* vs. *Phaeocystis*)?
- How do these differences affect biogeochemistry?

Process understanding for contrasting years



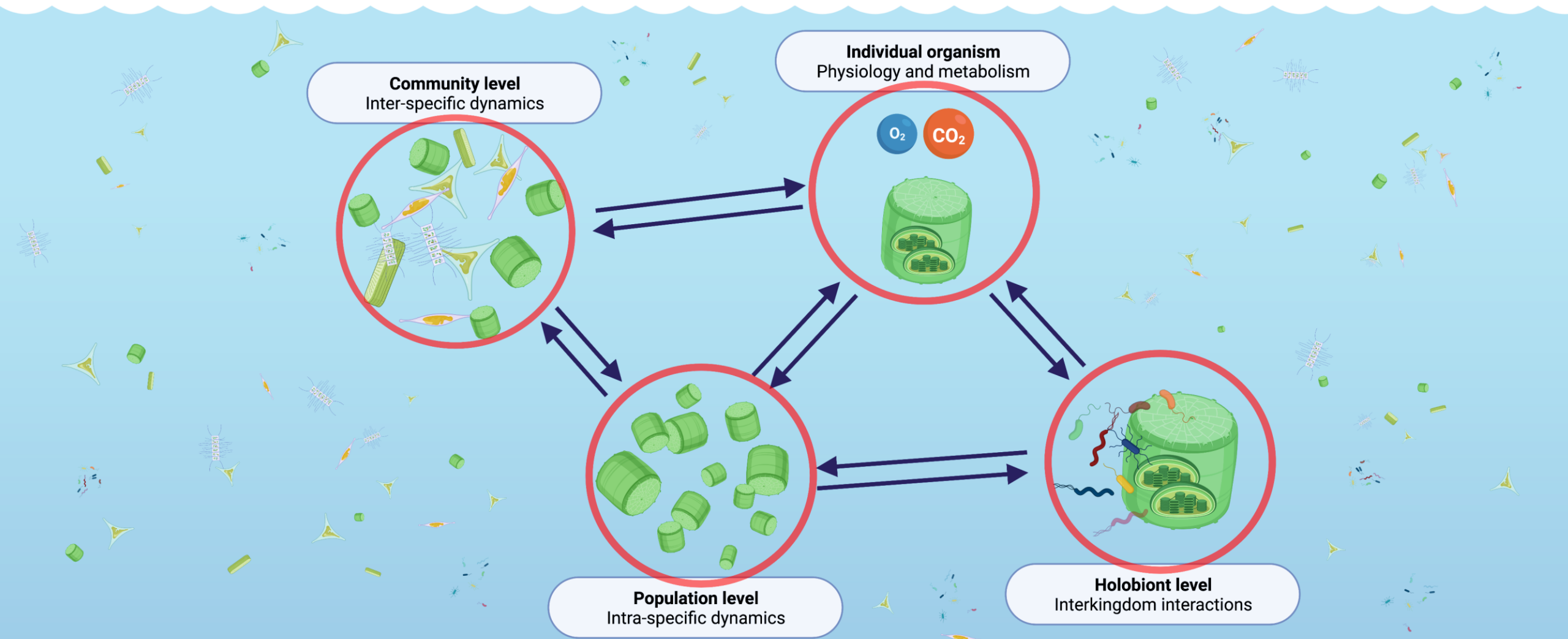
- Spring bloom species composition differs between years



- This has large impacts on ecosystem functions and biogeochemistry, e.g. diatom dominated blooms cause larger CO₂ drawdown

➤ What are the underlying mechanisms?

Reciprocal interactions between all levels of adaptation



Thank you!

