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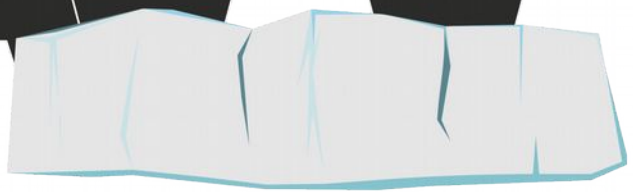

GLACIERS RETREAT AND FIORDS WITHER

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NATIONAL SCIENCE CENTRE
POLAND

Institute of Geophysics
Polish Academy of Sciences

Western Norway
University of
Applied Sciences

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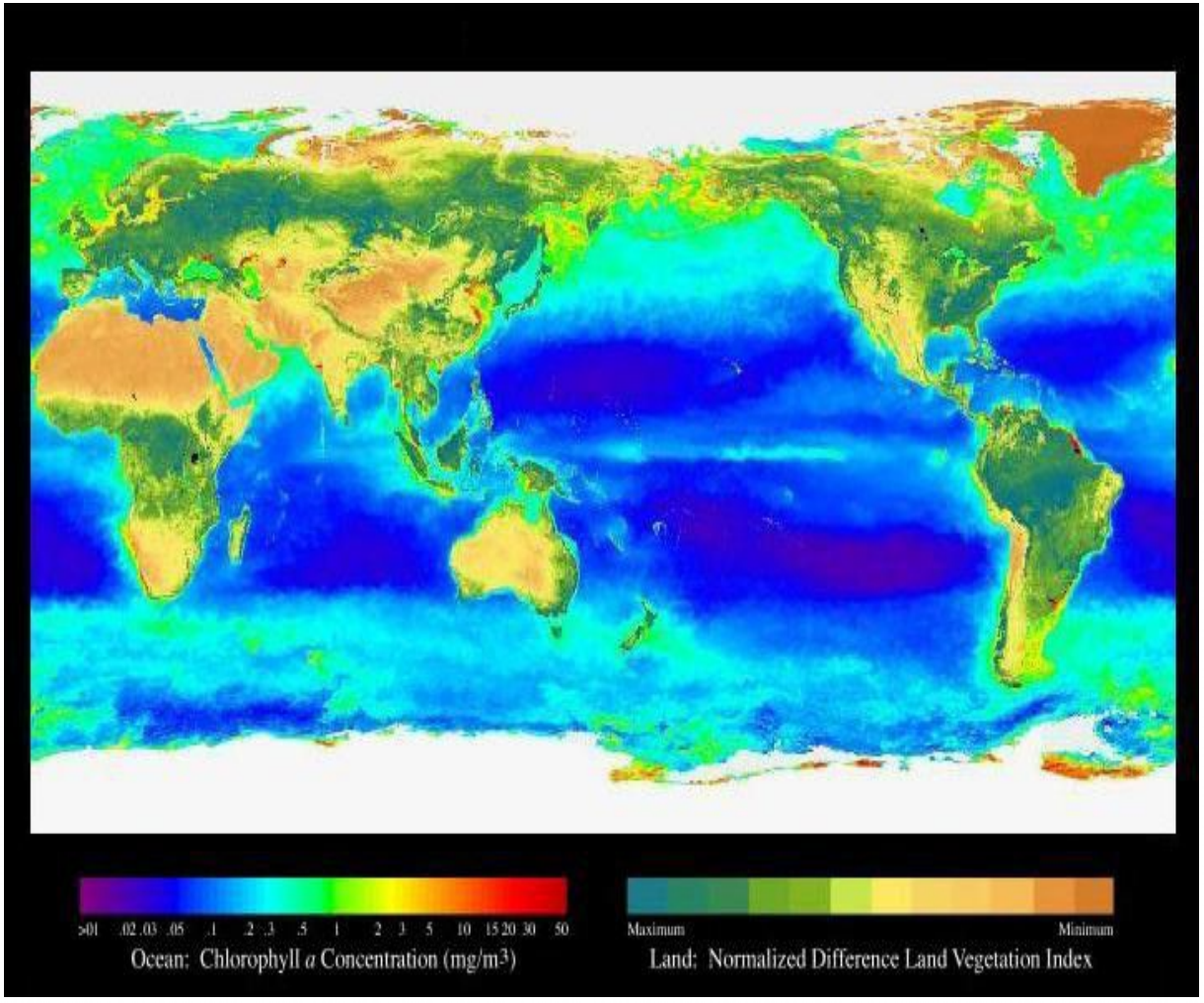
Marine productivity conditions drive to a large degree the air-sea CO_2 exchange. The Arctic Ocean, due to its relatively high primary productivity and low water temperatures is responsible for as much as 14% of the global CO_2 uptake by marine regions (Bates and Mathis, 2009). It makes the Arctic marine ecosystems an important component in the global carbon cycle. The recent findings (Ericson et al. 2018, 2019; Smith et al. 2015) showed that Arctic fjords are especially effective in absorbing atmospheric CO_2 and burial of organic matter in the sediments.



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Example of international ocean studies examined the fertilization phenomenon:

- Ironex, 1995;
- SOIREE (Southern Ocean Iron Release Experiment), 1999;
- EisenEx (Iron Experiment), 2000;
- SEEDS (Subarctic Pacific Iron Experiment for Ecosystem Dynamics Study), 2001;
- SOFeX (Southern Ocean Iron Experiments - North & South), 2002;
- SERIES (Subarctic Ecosystem Response to Iron Enrichment Study), 2002;
- SEEDS-II, 2004;
- EIFEX (European Iron Fertilization Experiment), 2004;
- CROZEX (CROZet natural iron bloom and Export experiment), 2005;
- LOHAFEX (Indian and German Iron Fertilization Experiment), 2009;
- Haida Salmon Restoration Corporation (HSRC), 2012;

- ***' It is based on the reasoning that adding trace amounts of iron to iron-limited phytoplankton of the Southern Ocean will lead to blooms, mass sinking of organic matter and ultimately sequestration of significant amounts of atmospheric carbon dioxide (CO2) in the deep sea and sediments. This iron hypothesis, proposed by John Martin in 1990 (Martin 1990 Paleoceanography5, 1–13), has been tested by five mesoscale experiments'***
- *Smetacek V. i in. 2008. The next generation of iron fertilization experiments in the Southern Ocean. Phil. Trans. R. Soc. A 10.1098/rsta.2008.0144*

- ***'Fertilization of the ocean by adding iron compounds has induced diatom-dominated phytoplankton blooms accompanied by considerable carbon dioxide drawdown in the ocean surface layer.'***
- *Smetacek V. i in. 2012. Deep carbon export from a Southern Ocean iron-fertilized diatom bloom. Nature 487, 313-319*

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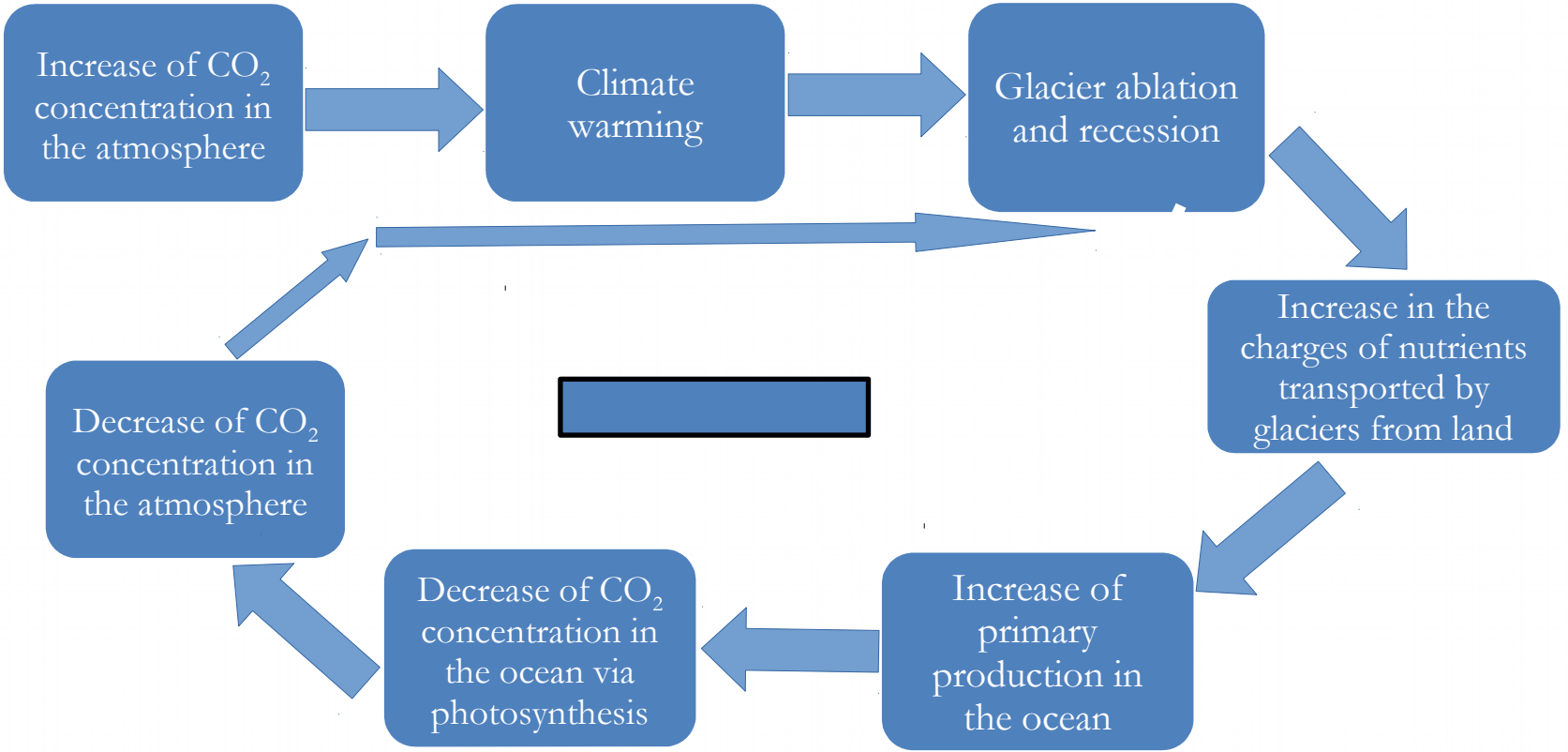
Negative feedback effect with CO_2 concentration via photosynthesis (De Baar et al. 2008; Gerringa et al. 2012)



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But .....

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Meire et al. 2016 Highe export of dissolved silica from the Greenland Ice Sheet. *GRL*

Meire et al.,2017 Marine-terminating glaciers sustain high productivity in Greenland fjords. *Global Change Biology*

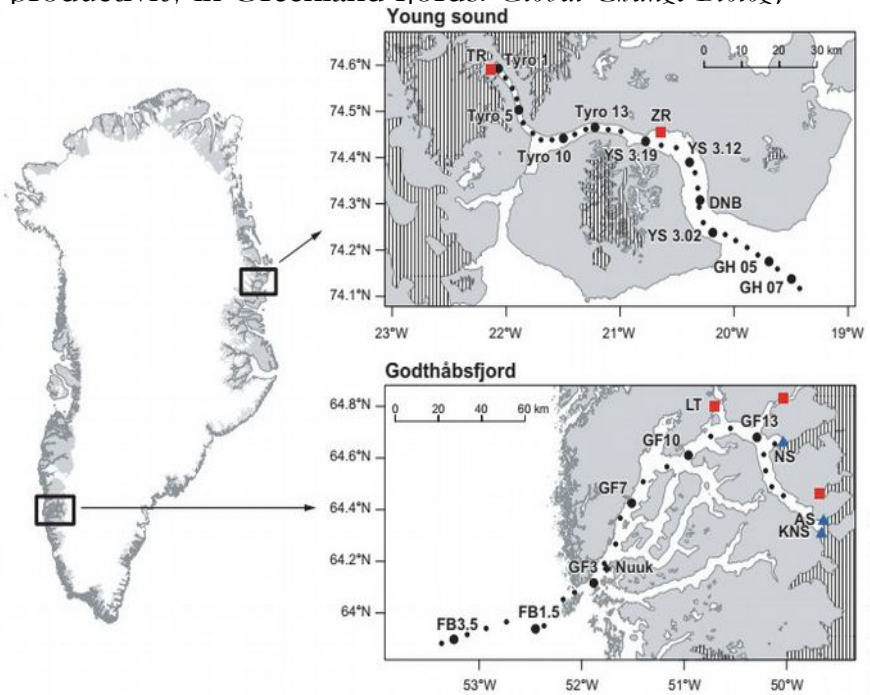

FIGURE 1 Map of Young Sound and Godthåbsfjord indicating the stations (solid dots) along a transect from the Greenland Ice Sheet (shaded area) towards the mouth of fjord region. Marine-terminating glaciers in Godthåbsfjord are indicated by blue triangles (NS, KNS and AS), major meltwater rivers in Godthåbsfjord and Young Sound by red squares (Lake Tasersuaq LT; Zackenberg river ZR; Tyroler river TR)

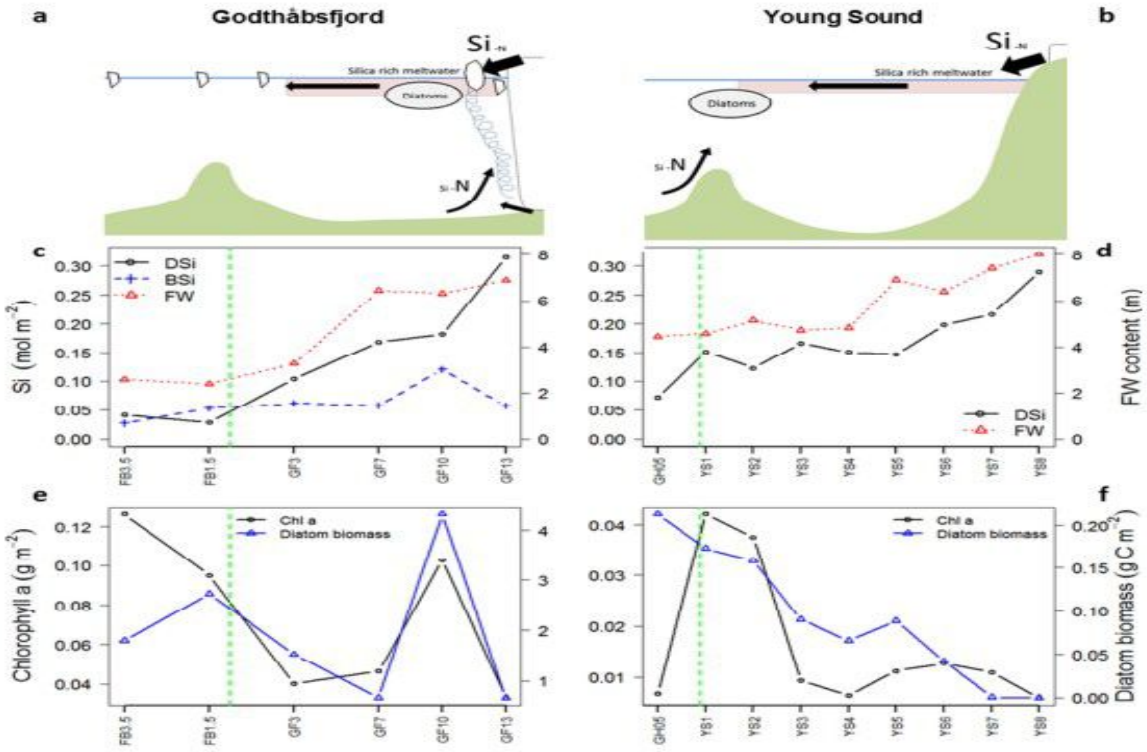

Figure 2. Conceptual model on the link between meltwater runoff rich in silicate and diatom blooms in a fjord system impacted by marine and land terminating glaciers (a,b). Integrated concentrations in the upper 40 m along a length transect in August from the inner fjord (right) to the open shelf area (left) in Godthåbsfjord (c) and Young Sound (d). For Godthåbsfjord both dissolved silica (DSi, black) and biogenic silica (BSi, blue) are shown alongside the freshwater content (FW, red). The green dashed line indicates the mouth of the fjord. Panel e and f show the integrated chlorophyll *a* concentration (g m^{-2}) and diatom biomass (in g C m^{-2}) in the upper 40 m for Godthåbsfjord (e) and Young Sound (f). Note the different scaling for chlorophyll and diatoms biomass between Young Sound and Godthåbsfjord.

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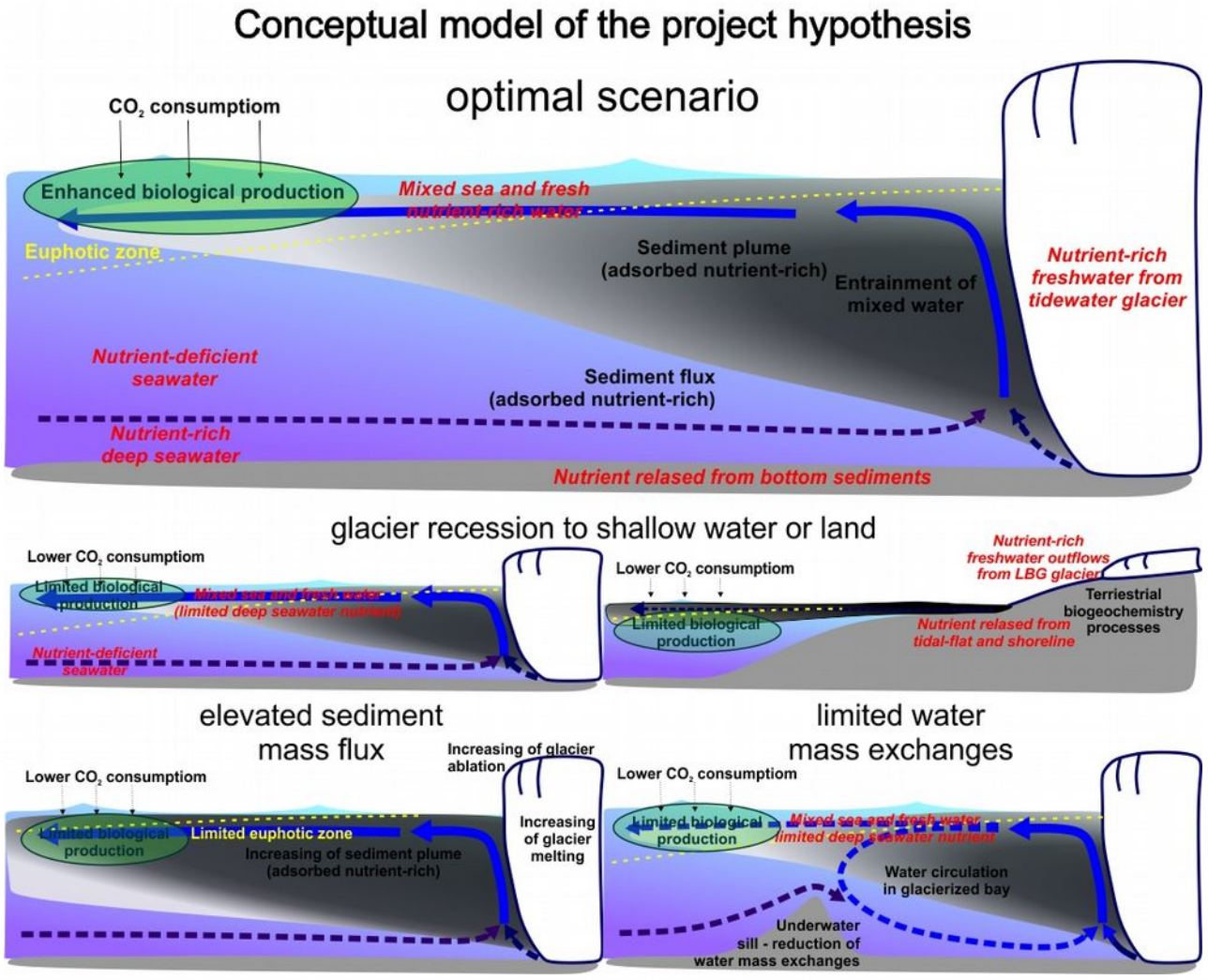
Project hypothesis:
The warming-driven glacier recession causes a reduction in marine biological production in polar coastal regions and seas due to:

- unfavorable nutrient balance caused by a reduction in nutrient-rich deep water upwelling from buoyant meltwaters plumes;
- shallowing the euphotic zone caused by increased surface suspended sediments concentration;
- reduction of water mass exchanges and sediment-bound nutrients transfer between the fjord/open sea and newly formed bay due to hydrography and formation of natural sediment traps.



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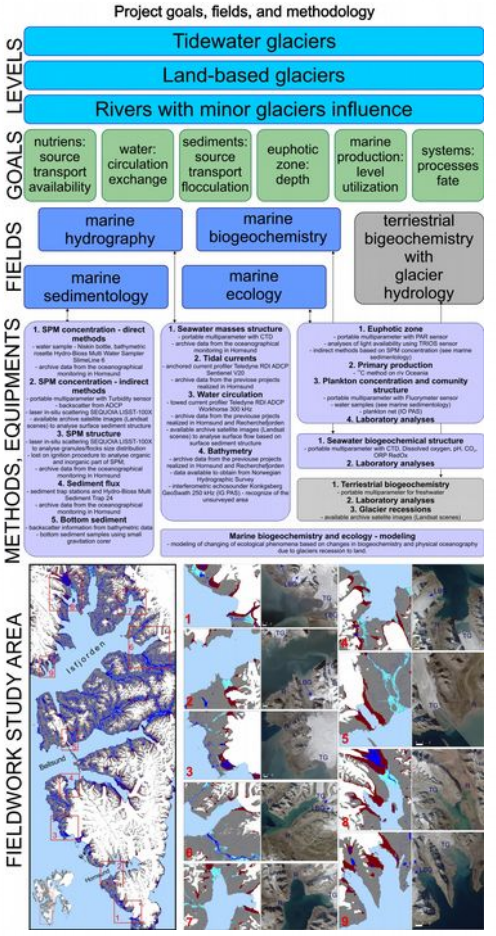
„RAW – Retreat And Wither”

What is the influence of glaciers recession from tidewater to land-based on the marine biological production and biogeochemistry in the Arctic?



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