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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?

Mateusz Moskalik and working group

The productivity of marine ecosystems is an important factor in conditioning elements and organic matter cycling on Earth. It also influences the composition of the atmosphere and thus shapes our climate. The world's oceans are a great source of O_2 and sink for atmospheric CO_2. They absorb more than 20% of anthropogenic CO_2 emissions and therefore limit global warming. The Arctic Ocean, due to its relatively high productivity and low water temperatures enhances CO_2 solubility, is responsible for one-tenth of the global CO_2 uptake by marine regions. This makes the Arctic marine ecosystems important components in the global carbon cycle. Recent findings show that Arctic fjords are especially effective in absorbing atmospheric CO_2. The biogeochemistry of the fjord systems is, however, very complex and not yet fully understood. The great unknowns that remain include the effect of glacial retreat on the CO_2 budget of coastal waters.

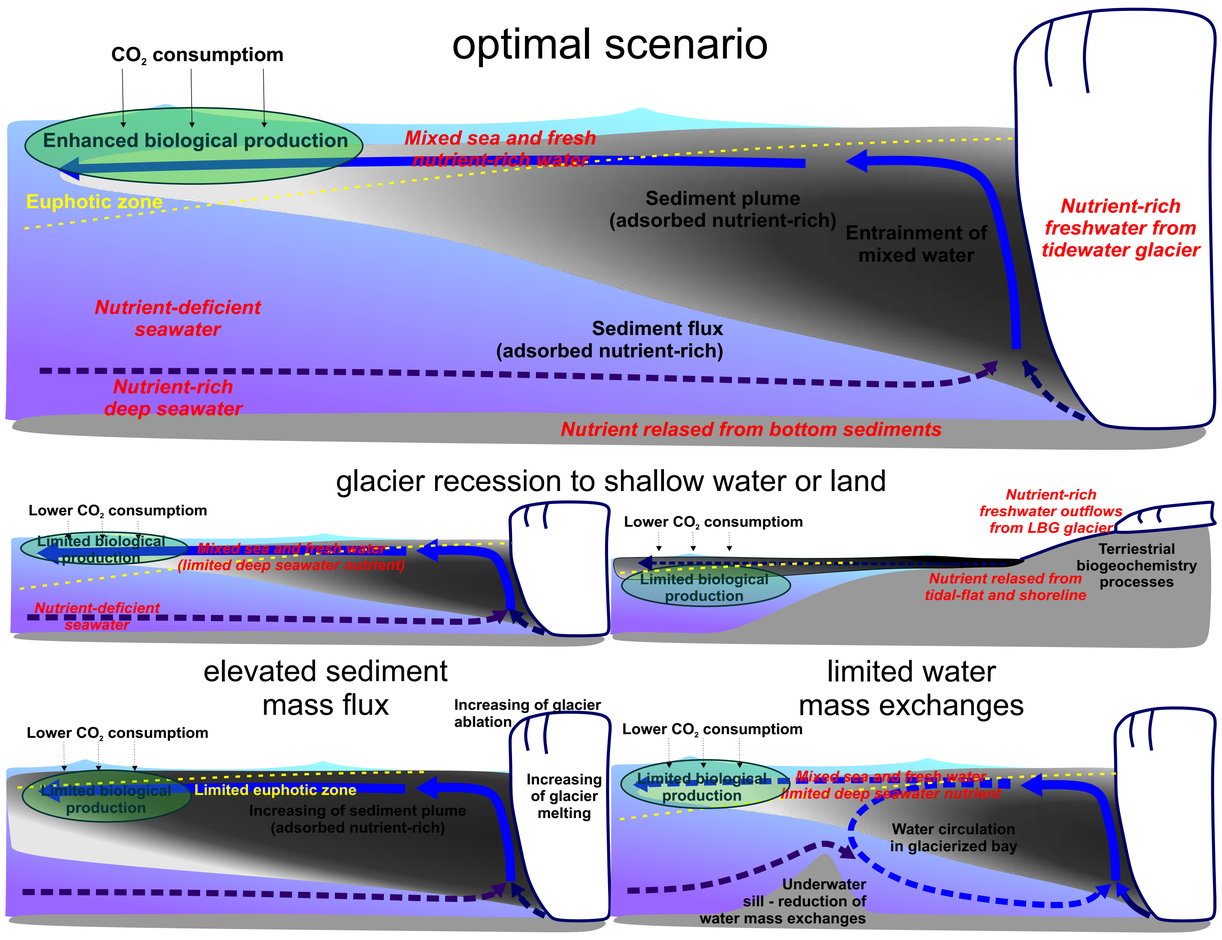
Climate change is disproportionately strong in the Arctic, which is the most rapidly warming region on Earth. One of the observable consequences of the transformation of the Arctic environment is the rapidly receding glaciers. Due to glaciers' calving, submarine melting, and drainage of meltwater through glacial outflows, glaciers are recognized as the main source not only of freshwater supply into the fjord, but also mineral, organic matter, and nutrients. These nutrients affect marine primary productivity in the areas where there are tidewater glaciers. However, there is a growing body of evidence suggesting that deepwater upwelling at the terminus of tidewater glaciers causes the most important increases in primary production. These deep waters are usually rich in nutrients, including nitrogen. Near the land-based glacier inputs, where low nitrogen availability in meltwater limits productivity. Furthermore, sustained glacier recession will change the glacial regime from predominate tidewater to land-based. The current oceanographical, sedimentological, and biogeochemical conditions will, therefore, adopt more characteristics of land-based glaciers and non-glacial inputs. This, in turn, may alter the total nutrient flux supplied to the euphotic zone. Therefore, it remains uncertain how the marine ecosystem productivity will respond to future changes in the Arctic.

Project hypothesis

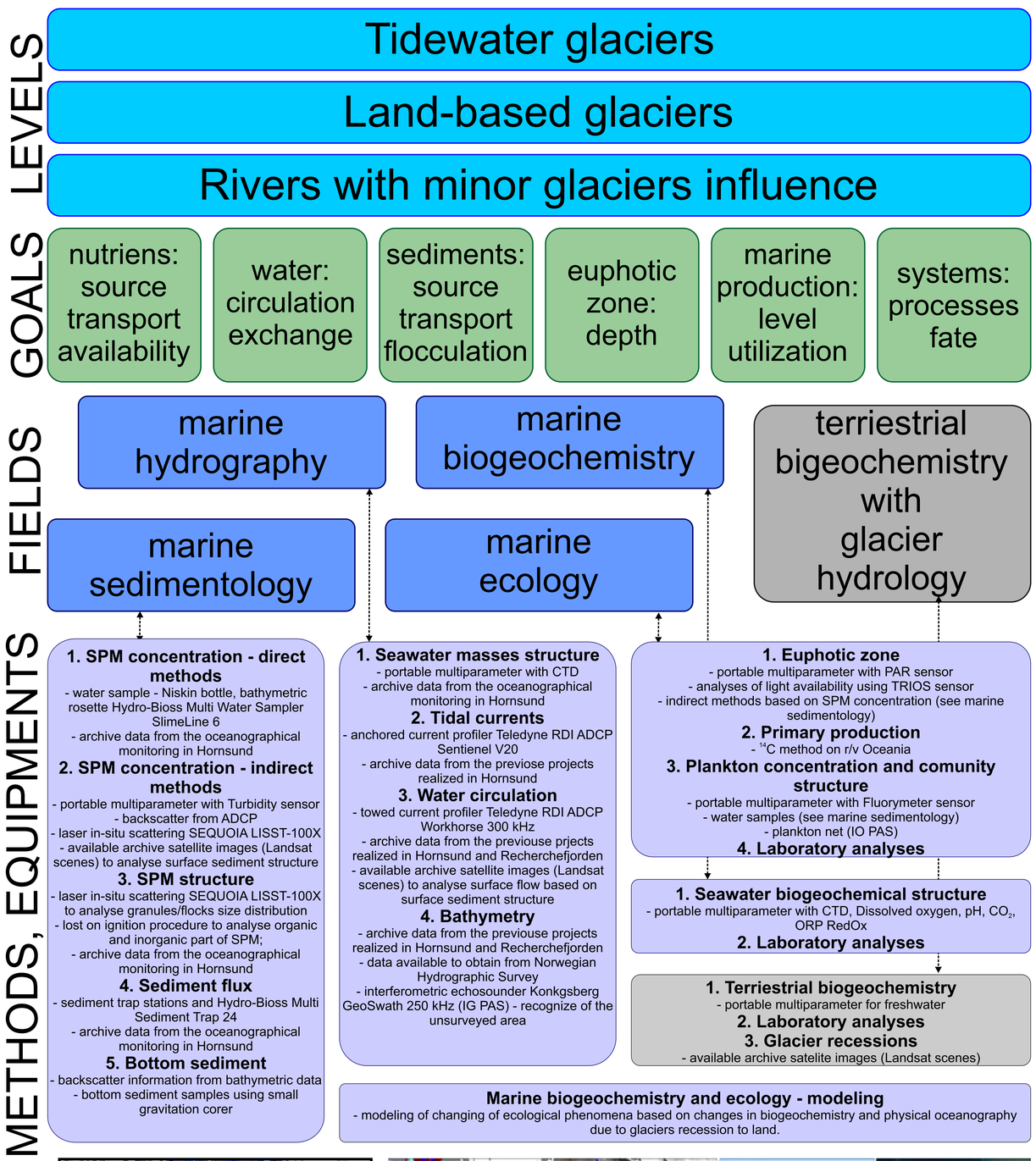
The warming-driven glacier recession causes a reduction in marine biological production in polar coastal regions and seas due to:

- **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.**

Conceptual model of the project hypothesis



Project goals, fields, and methodology



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