Summary

Rationale

The Earth system changes at a rapid pace, with serious regional or even global consequences. These are for instance: climate change, global warming, sea level rise or ocean acidification. The root cause of all these changes is continuously rising CO_2 concentration in the atmosphere. This increase is partially mitigated by the world ocean, which absorbs about 22% of anthropogenic CO_2 emissions. Most of the mechanisms shaping the CO_2 content in seawater are identified, even though some of them have not been perfectly parametrized yet. However, there is one feedback loop that has entirely escaped the attention of Earth system scientists so far, but may exert a significant impact on the Arctic marine ecosystems and the global carbon cycle. This is the influence of organic acids released from permafrost via their acidic functional groups on the acid-base balance in the marine environment. This interaction together with remineralization of permafrost-derived dissolved organic matter (DOM) have a potential to change the marine CO_2 system and seawater pH (Fig. 1).

Hypothesis and objectives

DOM comprises numerous organic substances, with acids as an important fraction. The main hypothesis in the project assumes that ***DOM released from permafrost is highly bioavailable and contains sufficient loads of organic acids to contribute significantly to the ocean acidification and to change the marine CO_2 system substantially in the Arctic shelf seas***.

To verify this hypothesis the following objectives have been set:

1) to characterize the acid-base properties of the DOM released from various permafrost sites,
2) to quantify the influence of organic acids of different strength and concentration on the marine CO_2 system at different conditions of total alkalinity and pH,
3) to assess lability of permafrost-derived DOM
4) to estimate the extent of the DOM impact on the marine CO_2 system and seawater pH.

Methodology

The significant part of the study will focus on the characterization of the acid-base properties of DOM, originated from different permafrost sites located in Spitsbergen (Svalbard) and Greenland. Another task will be oriented on characterization of the permafrost-derived DOM bioavailability and quantification of CO_2 release from its remineralization. Furthermore, detailed marine CO_2 system studies are planned in the coastal Arctic regions affected by the organic acids released from permafrost.

All the experimental data gathered in the project is going to be compiled with the results of numerical tests and used to parametrize comprehensively the DOM influence on the marine CO_2 system so that these mechanisms can be included in the biogeochemical models. This, in turn, is necessary for predicting future seawater pH changes and CO_2 fluxes across the air-sea interface in the marine regions affected by thawing permafrost and hence also for managing such issues as ocean acidification in the future warm, CO_2-rich world.

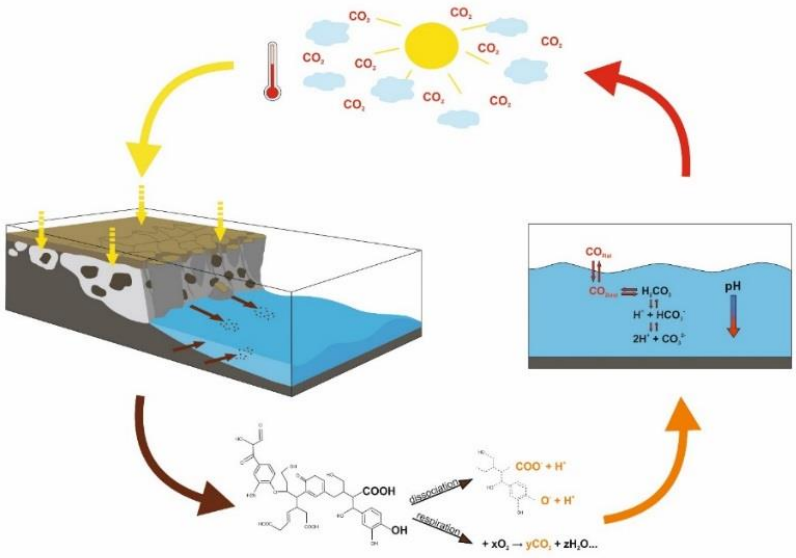

Fig. 1. Conceptual scheme showing the combined influence of permafrost-released dissolved organic matter on the marine CO2 system.