Summary for the general public

Lakes are natural bioreactors that receive, store and transform globally important amounts of organic matter. The great majority of lakes is considered as net heterotrophic and regarded as greenhouse gas (GHG) source to the atmosphere. Canonically, lacustrine GHG oversaturation results from rapid respiration of a large organic matter subsidy imported to lakes from catchments. However, despite continuous inputs, some Arctic and Alpine lakes are seasonally becoming GHGs undersaturated (i.e., in CO_2 and N_2O), through either biological or chemical processes, and potentially represent an important, yet overlooked, sink for atmospheric GHGs. In fact, we anticipate that the saturations of GHGs in these remote lakes fluctuate largely depending on the efficiency of the cross- and within ecosystem connectivity effects that moderate the organic matter import as well as on the efficiency of transport between sediments and the water column. The rate of ecosystem connectivity as well as the character, timing and distribution of the imported organic matter will reflect the hydroclimatic, hydrodynamic and biogeochemical conditions. Considering that the effects of recent climate change are strongly altering both the climate and the geochemistry of high latitude and altitude regions, we aim to verify how the change in warming-impacted cross- and within- ecosystem connectivity between terrestrial, aquatic and atmospheric environments influences the organic matter and GHGs fluxes in Arctic and Alpine lakes (i.e., lake Revvatnet – Svalbard; Nigardsvatnet – Norway as well as lakes Nero, Bianco and Dentro – Switzerland). This overarching goal will be reached by examining climate-relevant mechanisms related to changes in the organic matter and GHG pools in high latitude and altitude lakes at the daily, through interannual to century timescales. We will, most specifically, look into the effects of:

- direct warming-driven increase in the import of labile OM to lakes and associated increase in their GHGs saturation levels
- change in the frequency of pulse OM inflows to lakes that results in a decreased water transparency and exponential increase in the GHGs production
- extension of the ice-free periods in lakes and catchments allowing for higher organic matter loads and longer periods of time when GHGs evade directly to the atmosphere
- higher biological productivity, through efficient exploitation of imported OM and nutrients, enhancing biological CO_2 sink while stimulating CH_4 and N_2O source
- stimulation of the chemical CO_2 sink through more intense weathering in catchment and higher import of carbonates and silicates to surface waters.

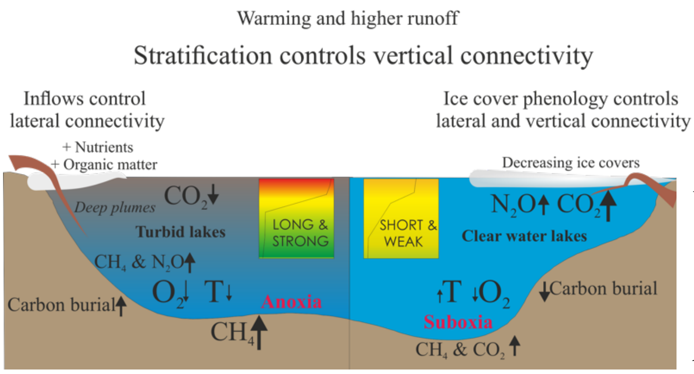

Fig. 2. Scheme of selected ecosystem connectivity effects on the metabolism and GHGs (CO_2, CH_4 and N_2O) in turbid and clear water Arctic and Alpine lakes

The goal of the “CONGAS” project is to achieve a mechanistic understanding of the ecosystem connectivity effects on organic matter flows and GHGs fluxes in Arctic and Alpine lakes and catchments under climate change effects. Such understanding will allow us to better constrain the role of high altitude and altitude lakes in the global GHGs budget and will lead to improved future forecast. The results of this research project will be broadly disseminated during Polish and International scientific meetings and workshops. The overall climate-driven mechanism that will originate from the interdisciplinary research effort during the CONGAS project will be interesting and important for general scientific community, national and international policy makers and broad public.