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Frozen peatlands: carbon store and the climate change

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Peatlands soils in the northern permafrost region store approximately 40% of total Earth's soils carbon. These soils develop under the influence of cryogenic processes especially such as freeze-thaw and cryoturbations. Climate change predictions suggest that the frequency of soil freeze–thaw cycles (FTCs) will increase in cool temperate and other high-latitude regions. This trend may cause a response in organic matter decomposition rate – that will result in significant changes of greenhouse gases emission (CO_2, CH4). For further predictions improvement of soils response to global climate changes it is necessary to estimate the impact of FTCs in permafrost soils on organic matter decomposition.
We investigated the effects of FTCs on microbial biomass, basal respiration, metabolic quotient and dissolved organic matter (DOM) content (carbon – DOC and nitrogen – DON) in frozen peatlands soils by laboratory modelling experiment. Frozen peatlands from the north of Western Siberia in Nadym area (N65°19′, E72°53′), in a zone of discontinuous permafrost were studied. The soil cover of these formations is represented by a complex of Typic Histoturbels (Turbic Cryosol) and Typic Historthels (Cryic Histosols). Peat profiles of both soil types were divided into horizons due to decomposition degree (from 15 to 55-60%), age (from 1000 to 5700 yrs) and botanic composition (oligotrophic, mesotrophic, eutrophic). During the experiment, first group of samples of peat horizons (field moisture content) were subjected for 10 times to 3-day FTCs at the temperature of -10 and +4 ° C. In the second group of peat samples were incubated at +4 ° C (with no freeze-thaw).
It was established that all studied microbial properties were inversely proportional with decomposition degree of peat, except metabolic quotient. Our results illustrate that microbial activity, estimated by BR, shows resistance to FTCs and doesn't significantly differ after FTCs an average. Microbial biomass (carbon and nitrogen) as well as BR doesn't differ too. The most intensive response to FTCs shows DOM content value which was 1.5 times higher on average in samples after FTCs in comparison with control samples. We suppose that increase of FTs frequency in soil will result in significant acceleration mineralization of peat. Because these processes exert disruptive effects on soil organic matter, provide converting carbon from pool into forms available for microbial communities, thus involving stored carbon into the carbon turnover.