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Temperature sensitivity of frozen peatland soils organic matter decomposition (North-Western Siberia, Nadym site, Russia)

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Peatland soils play a considerable role in carbon cycle because of storing approximately 50% of total Earth's soils carbon. The steady temperature increase in arctic soils may cause a rapid organic matter decomposition in thawed layers – that will result in additional significant greenhouse gases emission (CO_2, CH4). For further predictions improvement of soils response to global climate changes it is necessary to estimate the temperature sensitivity of soils organic matter decomposition.
The purpose of the study was to estimate the response of frozen peatland soils organic matter to increase in the temperature of their functioning. The study object was frozen peatland soils of forest-tundra (the Tyumen region), developing under permafrost conditions. Weakly and medium decomposed moss peat samples were taken from different depths for laboratory studies and stored at 4 °C before the experiment started.
At laboratory the response of CO_2 efflux, basal respiration (BR) and soils enzymatic (esters) activity (SEA) to temperature increase was estimated. For 1.5 months one part of peat samples was subjected to sequential temperature increase from 4 to 25 °C and CO_2 efflux was measured. Another part of the peat samples was simultaneously incubated at 4, 15 and 25 °C for 1-4 days for BR and SEA estimation. To identify the specifics of frozen peatland soils response the identical experiments were done with peat samples from southern taiga (the Moscow region).
First results showed the contrast response of peatland soils from different ecosystems to temperature increase. For all studied soils the positive feedback to temperature increase was noticed, however the organic matter mineralization rate, estimated by CO_2 efflux, differed a lot. The CO_2 efflux values of forest-tundra samples were 3 times lower in comparison with southern taiga on average: the maximal difference was at 16-22 °C range. The microbial biomass activity, estimated by BR and SEA, also tended to increase with temperature for both peatland soils. The BR values of forest-tundra samples in comparison with southern taiga were 1.5 times lower on average, whereas SEA values caused the more significant difference: starting from 4 °C the forest-tundra samples SEA was presented by a factor of 100 lower values if compared with southern taiga samples.
The temperature coefficient Q10, calculated on the basis of CO_2 efflux values, revealed the maximal forest-tundra samples temperature sensitivity in «low» temperature range 4-13 °C (Q10=4,1). For the southern taiga samples only small Q10 variations (from 2.5 to 2.2) with increasing temperature were fixed. Thus, we have found that the contrasting temperature sensitivity results are related to peatland soils from different ecosystems. This fact must be considered when predicting the peatland soils response to changes in functioning conditions.