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South tundra ecosystem feedback on temperature increasing and permafrost thawing

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As permafrost cover the quarter of the world and more than a half of Russia, it is necessary to study the permafrost ecosystem response to warming. Arctic ecosystems are sensitive indicators of environmental change. Considerable carbon store which exist in soil and is conserved in permafrost, is susceptible to climate changes especially to soil temperature and moisture ones. It is believed that increasing of temperatures of soil of the Arctic ecosystems can lead to substantial growth of the CO_2 efflux between soil and the atmosphere and carbon balance shift.
The goal of this study is to estimate tundra ecosystems response to warming and permafrost thawing, namely to investigate the changes of biological activity of soil as the result of long-term warming.
An unique object is used in our studies. Since 1960 the gas industry grows in Russia especially in Arctic. The hydrocarbons in the heated state are transferred by pipelines that were buried into ground, that cause permafrost degradation and soil warming. Now we can observe the effect of long-term experiment of warming of this ecosystem located along pipeline.
Plot with maximum transformation of vegetation along pipelines in tundra of Taz peninsula were selected by remote sensing. The main studies were carried out in the polygonal ecosystems with organic soil and frost boil ecosystem with mineral soil. Ten transects of 50 meters in length with sampling points every 5 meters from pipeline to undisturbed background area were selected on august 2016-2017. Soil and vegetation were described, soil temperature and moisture, the throw depth and CO_2 efflux were measured in each point. Based on field data, zones of transformation of ecosystems along the pipeline, that significantly differ in temperature and thaw depth from natural areas are distinguished. The similar measurements were made in tenfold in these zones.
In the laboratory we investigated the biological activity of soil samples: basal (BR) and substrate-induced respiration (SIR) and the content of labile carbon (LOC). As a result of the pipelines operation, permafrost thaw (from 0,4 to 6 m), soil temperature increase (from 2.9 to 6.7°C) and soil moisture change by 15% in area up to 30 m. The most rapidly react vegetation: woody vegetation rises (from 20 to 70%) and the height of Betula Nana increases (from 13 to 86 cm). Ecosystems are characterized by CO_2 double efflux (from 95 to 210 mgC/g soil). In soils after prolonged warming the biological activity drops (BR by 2.5 and SIR by 3 times) when content of LOC decrease by 1.5 times.
It is established that frost-boil and polygonal ecosystems react differently. The fall of LOC content and biological activity is more pronounced in mineral soil (by 2-2.5 times), in contrast to organic soil (by 1.5-2 times). The CO_2 efflux increase similarly although its value in organic soil is less than in mineral.
Thus, as a result of long-term warming of ecosystems and permafrost degradation, we found a significant feedback from structure and composition of vegetation, CO_2 efflux and biological activity of soils.