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Effect of wetting/drying on biological activity of palsa peat soils on north of Western Siberia

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Peatlands store 30% of the world's terrestrial soil carbon and those located at northern latitudes are expected to experience rapid climate warming. Drainage and water-logging of peat soils that occur during the melting of permafrost, can have a great effect on the mineralization of soil organic matter, and therefore can both increase and reduce CO_2 emissions into the atmosphere. The predicted climate warming may affect the soil moisture and the related biological activity of the peat soils of permafrost area.
The aim of this work is examine the effect of soil moisture on the biological activity of peat soil, developing in permafrost area. We are study palsa peat soils on the north of Western Siberia, Russia, (30 km south-east of the Nadym city). The soil cover develops in semi-hydromorphic and automorphic conditions. Permafrost is at the 50-60cm depth. The object of this study is histosol.
Within two weeks in August 2018, an experiment was conducted, in the course of which the peat soil (n = 4) was wetted with distilled water. After irrigation, CO_2 emissions were measured at experimental and control sites (without irrigation) using the closed chambers method.
The average CO_2 flux in the control plots amounted to 40.7 $\pm$ 12.9 mgCO_2 / m2 / h, with moderate temperature and moisture fluctuation (8.5–9.5°C and 26.2 $\pm$ 1.7%). The CO_2 flux significantly increases (4-5 times) after wetting to 38.5 $\pm$ 7.8% and reaches 186.1 $\pm$ 28.6 mgCO_2 / m2 /h. The soil temperature changed slightly (8-10°C).
To clarify the response of peat soils to wetting, a laboratory experiment was conducted. Peat samples of different properties (Oi, Oa) (n = 3) taken from soil of palsa were brought to moisture from 20% to 100% (in steps of 10 %) water holding capacity (WHC). After pre-incubation at 25°C, the rate of mineralization of organic matter (basal respiration) was estimated.
The basal respiration (BR) of the Oa is significantly lower than that of Oi, reflecting the specifics of the horizons genesis. The BR of Oa increases from 0.03 mg $\pm$ 0.02 -CO_2/ g/ h at 20% WHC to 3.27 $\pm$ 0.19 mg -CO_2/ g/ h at 100% WHC. BR of Oi grows linearly with an increase in moisture content from 0.41 mg $\pm$ 0.09 -CO_2 / g/h at 20% WHC to 15.23 $\pm$ 0.55 mg -CO_2/ g / h at 100% WHC. Both horizons are characterized by a similar trend of increasing BR up to maximum values of peat moisture. A significant decrease is observed only at low values of moisture (less than 20% WHC).
Thus, a peculiarity of peat soils is a wide range of moisture, in which the rate of organic matter mineralization is high. In a changing climate, the temperature of the soil rises and the ecosystems humidity probably increases as the permafrost thaw. Both factors can accelerate the mineralization of organic matter in peat soils.