Natural and disturbed forests of Siberia: soil emission of CO2

Krasnoyarsk scientists have analyzed the seasonal dynamics of soil emission of carbon dioxide (CO_2) for various types of ground cover in the subzone of the middle taiga of Central Siberia over five vegetation periods. It was found that in pine forests growing on sandy soils, the level of CO_2 flow from soils during the summer period depends primarily on moistening conditions, and only then does it depend on the temperature and type of ecosystem. Hence, biogeocenoses formed in Central Siberia are especially sensitive to changes in precipitation, especially to the abnormally sharp ones. The main findings of the study can be found in Russian Journal of Ecology (RUSS J ECOL+).

The CO_2 flow from the soil is one of the most important components of the global carbon cycle. The carbon cycle is a balance between CO_2 absorption by terrestrial vegetation (plants use it for photosynthesis) and CO_2 release during the so-called respiration of soils and plants. It is known that the soils of the forested part of our country contain 4 times more carbon than living phytomass. As CO_2 storages, soils can retain carbon dioxide for centuries. And human intervention in this finely tuned process is fraught with long-term consequences.

'We have analyzed and summarized data on soil temperature and moisture content, which were collected from June to September during five growing seasons. At the same time, we found an indicator of threshold moisture at which we did not observe any restriction of the flow of carbon dioxide by deficient moistening for different ecosystems. The article also provides a calculation algorithm based on the data collected to find out exactly what the humidity indicator restricting the CO_2 flow in a particular region will be. We believe this scheme will work in any corner of the world where taiga ecosystems are,' said **Anastasia Makhnykina**, junior researcher of the Laboratory of Biogeochemistry of Ecosystems, SibFU.

The scientist noted that these data are already being used to simulate the seasonal CO_2 flow to predict taiga breathing during the season. In the future, it is planned to expand the scale of the model for several years and even decades.

> *'We have all felt that the climate is changing, and changing quite rapidly. Arctic ice is melting, southern Siberia is increasingly suffering from drought. Unfortunately, it is the boreal forests of Siberia that are least adapted to the impending changes, and for our forests, these new realities are the most destructive. Observing the dynamics of CO_2 emission, we can figure out how the Siberian coniferous forests, the lungs of Earth, will change, and what our descendants will see,'* asserted **Ms. Makhnykina**.

The ongoing observations additionally involved a study of disturbed areas affected by fires and man-made interference — devastation of forests and ploughing of land.

> *'In Turukhansk district, which we studied, there are practically no industrial enterprises. This region, however, is of great economic importance as one of the key region of timber*

harvesting, the pace of which is not decreasing. As for fires, every year in Krasnoyarsk Territory, specialists register a significant number of large foci, which can also become an additional source of CO2 in the atmosphere. If mankind is afraid of an uncontrolled intensification of the greenhouse effect (which, by the way, was even before human started a stormy economic activity, but has intensified just in recent years), it is time to think about the contribution of the disturbed ecosystems — territories affected by fires, lumbering, cultivation of land, and so on — to the emission of carbon dioxide. In our work, we took into account the specific features of each ecosystem during modeling and introduced them into the developed model,' said the scientist.

The joint team carrying the study comprised the scholars from Siberian Federal University, V.N. Sukachev Institute of Forest Health (SB RAS) and M.F. Reshetnev Siberian State University of Science and Technology.

The study was supported by the Russian Foundation for Basic Research, project No. 17-05-01257 and 18-34-00736

10 june 2020