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Ecosystem services of the city campus: carbon landfill of the RUDN-University

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Abstract. The approaches to the organization and the first results of the project on the organization of a carbon landfill at the Peoples ' Friendship University of Russia are presented. The topic of the absorption of greenhouse gases by natural ecosystems is one of the most actively developing. A complex of scientific and educational projects on climate change, decarbonization, and assessment of ecosystem services is being implemented at the RUDN University. One of the directions is our own carbon landfill on the campus. The object is of interest as a technologically modified ecosystem that is under the influence of anthropogenic sources. The analysis of ecosystem activity in the absorption of greenhouse gases and, accordingly, the assessment of ecosystem services of this type is implemented using the RUDN's own environmental monitoring network, which has been operating since 2017. Preliminary assessments allowed us to draw conclusions about the degree of transformation of ecosystem components and their contribution to the absorption of greenhouse gases. The project has both practical and educational significance and is considered as part of the package of strategic topics for the development of the university "Campus as a green lab", contributing to the achievement of sustainable development goals.

Keyword:

carbon landfill, environmental monitoring, RUDN, carbon footprint, ecosystem services

1. Introduction

The relevance of the issues of climate change, the causes and consequences of these processes is extremely relevant in recent decades. In this regard, new approaches are emerging to analyze the role of natural ecosystems in the absorption of greenhouse gases

and to quantify the actual ecosystem services for urban ecosystems.

RUDN actively develops scientific research and educational programs on this topic, participates in state programs for the validation and verification of greenhouse gases. Participation in the annual rating assessments of UI GreenMetric also stimulated the development of this direction. In addition, the need to review its own environmental and climate policy, as well as energy conservation issues.

Starting from 2020, a new project on the greening of the campus is being implemented at the RUDN University. One of its activities is the analysis of the state of the campus ecosystem. Despite the fact that the university is located in the city, a large green area makes it possible for the campus to "participate" in the process of assimilation of carbon dioxide and other greenhouse gases. The presence of our own detailed environmental monitoring system allows us to quantify these processes on the basis of the created carbon landfill, which covers the areas of the campus with different levels of anthropogenic loads.

2. Objects and methods

The object of a stuy is the territory of the RUDN University campus in the south-west of Moscow with an adjacent green forest park area. Earlier, we conducted detailed assessments of the levels of anthropogenic loads on the territory and clearly outlined areas with a predominance of various types of pollution. The data of the environmental monitoring system were used (33 points on 144 hectares of territory; in total, more than 4 thousand data from 2017).

Their main pollution source is transport activity (the campus is surrounded by highways of various traffic intensity, from several tens to several thousand cars per day). Data on marker compounds (polycyclic hydrocarbons, PAHs) in snow cover, soil, and vegetation were used as the basis for such estimations, including the indicator ratio calculations. The preliminary modelling justified the predominant role of the vehicle transport as a pollution source [2, 4-6].

The campus territory was divided into transport, socio-administrative and forest-park zones with quite different pollution modes, and, hence, ability of the soils and vegetation to participate in the greenhouse gases exchange (Fig. 1).

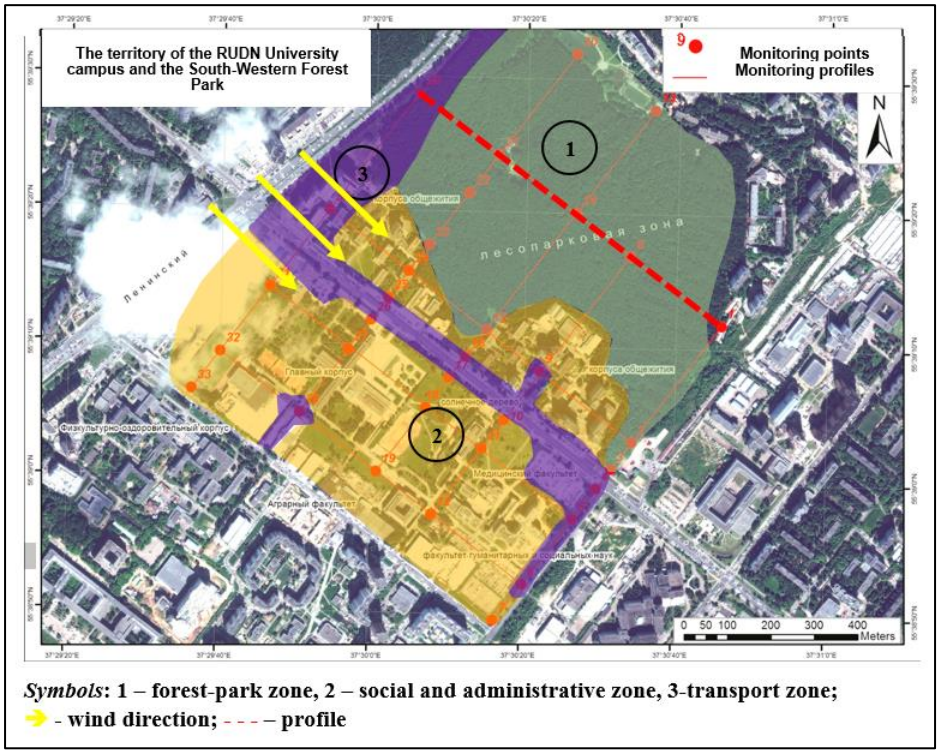

Figure 1. Zoning of the territory according to the conditions of anthropogenic load [1]

When developing methods for assessing ecosystem services for the considered territory, at the first stage, the emphasis is placed on CO2 gas exchange with the participation of ecosystem components. However, in future stages, it is also planned to control the flows of other greenhouse gases, including nitrogen oxides and ozone.

Daily observations were organized at the monitoring points, the concentrations of CO_2 in the soil air and the near-surface air layer (height of 1.5 m) were recorded. The daily fluctuations of the carbon dioxide concentration in both media are estimated, taking into account the variations of meteorological parameters.

In general, the work on the project includes the following main stages (Fig. 2).

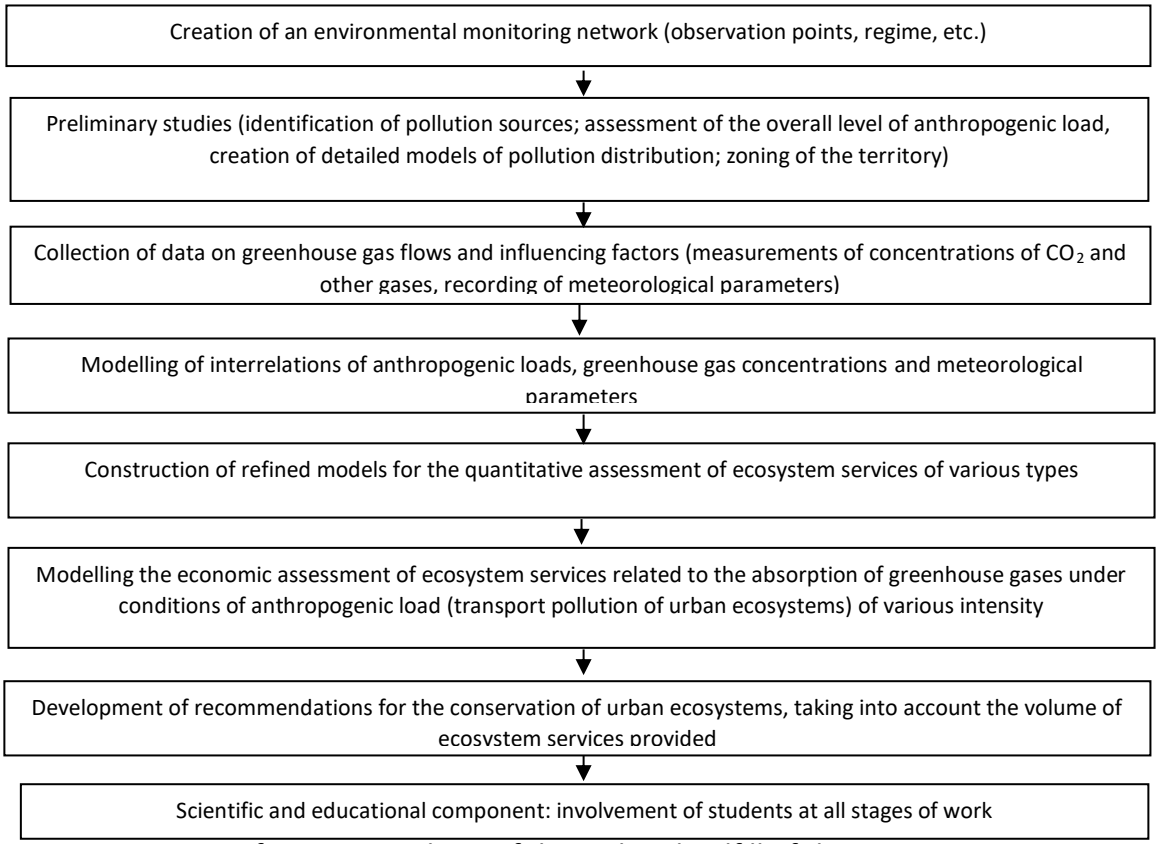

Figure. 2. Stages of creation and use of the carbon landfill of the RUDN University

Thus, it is expected to obtain a complete assessment of the ecosystem services created by the urban ecosystem, which is subjected to uneven anthropogenic load.

3. First results of the assessments

The measurements carried out in 2020 made it possible to establish correlations of various values between the concentrations of carbon dioxide in the soil air and in the atmospheric air. Thus, the maximum connections (r=0.95...0.98) were detected in areas with a high intensity of anthropogenic load (the transport zone of the campus). At the same time, the forest-park zone is characterized by much less pronounced relationships of CO_2 concentrations in the soil air and in the atmosphere (r=0.43...0.89) [3].

These r\interrelations can be explained by a significant change in soils in areas with increased anthropogenic load. Of course, these are only the first results of the assessment. For more clearly justified conclusions, observations over longer periods, detailed accounting of meteorological parameters, linking the activity of pollution sources, weather conditions, vegetation conditions and the actual concentrations of CO_2 in the soil air and in the atmosphere are necessary.

The results obtained are interesting not only as a justification of the most important role of urban ecosystems in the formation of a favorable environment. The economic assessment allows us to demonstrate the importance of the well-being of soil and plant systems for the normalization of greenhouse gas flows and their more active absorption by vegetation. At the same time, attention should be paid not only to tree plantations, but also to herbaceous vegetation as a very active CO_2 absorber. From this point of view, obviously, the most valuable is the developed lawn vegetation, and not subjected to constant trimming.

Another important result is the possibility of using our own carbon landfill for scientific

and educational purposes. The Institute of Environmental Engineering develops programs of basic and additional education related to climate change and decarbonization in various fields. Therefore, practical work on the territory of the university should become one of the integral elements of practical training, allow you to immerse yourself in the topic, starting with direct measurements and statistical processing and ending with the construction of ecological-geochemical and ecological-economic models for analyzing greenhouse gas flows and developing practical recommendations for decarbonization.

4. Summary

Thus, the creation of the RUDN carbon landfill is, in our opinion, an important direction for the development of environmental research on the campus. The study of greenhouse gases flows in the study area contributes to:

- establishing the regularities of the formation of concentrations of CO_2 and other greenhouse gases (primarily NO_x, O_3) through the use of unique factual data obtained on a high-frequency impact monitoring network;
- establishing the features of the formation of conditions for the absorption of greenhouse gases in zones with different levels of anthropogenic (primarily transport) load on urban ecosystems;
- obtaining reasonable ecological and economic models of the conditions for the absorption of greenhouse gases;
- development of the recommendations to increase the value of ecosystem services for the studied urban ecosystem;
- development of educational programs, including research works of students of various levels, from undergraduate to postgraduate;
- development of students' environmental culture through involvement in environmental research projects.

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