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APPLICATION OF GIS TECHNOLOGIES IN RADIOECOLOGICAL EVALUATION OF FLOOD-PLAIN LANDSCAPES

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It is proposed to use spatially distributed databases and GIS-technologies as a tool for solving radioecological tasks and tasks related to agricultural production on floodplain lands contaminated with radionuclides. In the basis of the work lies the analysis of more than 306 plant samples, 186 soil samples, 18 water samples. Two landscape profiles were laid on the investigated site. Structural and functional parts are characterized by 24 points of complex description with geographic coordinates and altitudes taken using the personal satellite navigator Garmin GPS12 XL.

Transformation of landscapes in the process of human agricultural activities and contamination with technogenic radionuclides has a significant effect on the existing natural flows of matter and energy. The negative consequences of technogenesis are becoming more pronounced. They often exceed the ecologically permissible limits and the ability of ecosystems to self-regulation, which leads to their destruction. Along with local and regional transformation of geochemical flows, tendencies of interregional and global changes are becoming more and more evident. The constant migration, concentration and dispersion of radionuclides change the ecological situation in the republic, therefore, landscape biogeochemical research and monitoring are very relevant for Polesye and other regions of Belarus. They allow to solve a number of practical questions in the field of fodder production, management of personal subsidiary plots, and, consequently, rehabilitation of the local population.

Increased technogenic pressure on agroecosystems requires a more flexible approach to the assessment of facilities for their contamination (radionuclide content in soil, products, water, etc.). A system of indicators characterizing the direction, intensity, and scale of biogeochemical processes in different landscapes and their elements is needed (the nature and rate of migration of radionuclides in the soil and beyond, the features of accumulation on geochemical and biogeochemical barriers). Such dynamic characteristics can be obtained only on the basis of identification of biogeochemical streams and structural-functional relationships in ecosystems [1, 2, 3].

Undoubtedly, the greatest attention should be paid to the soil cover. Soils perform the role of a buffer-like system in the landscape and are formed exclusively under the influence of other components of the landscape, being, in fact, their derivative. As a result, the soil cover most fully reflects the properties of natural complexes, their internal interrelations and the migration of chemical elements [4].

The most general evaluation of the migration-accumulative capacity of the ecosystem in relation to 137Cs 90Sr can be made on the basis of the probability of surface redistribution of radionuclides. And also the 137Cs 90Sr intake into surface runoff water in connection with geomorphological and lithological conditions. The probability of radionuclides entering the ground run in connection with the conditions of the hydrological regime. The possibility of deflationary movement of substances, accumulation of radionuclides in connection with the sorption properties of soils and the presence of biogeochemical barriers.

It was noted earlier that geomorphological processes have the most active influence on the differentiation of ecosystems, including the formation of a sculpture of the earth's surface. The role of the relief is especially important for the floodplain ecosystems of Polesye in conditions of technogenic contamination with radionuclides. This is due to the integrated approach to assessing the migration of radioactive substances in the floodplain, characterized by heterogeneity of the relief. Thus, a significant role in the development of the landscape-biogeochemical conditions of Belarus belongs to the terrain, which controls the thickness of the landscape, the relationship between geochemically autonomous and geochemically subordinated territories, determines the intensity of water exchange, and thus the formation of a system of migratory flows. However, the issues of geochemical classification of relief types and relief analysis as a landscape factor are at the initial stage of the study [5, 6] and no final solution has been found yet. Therefore, a comprehensive assessment at the ecosystem level taking into account geomorphological (relief) conditions and mandatory allocation of structural parts (facies elements) (figures 1-3) is the priority area of research on floodplain lands contaminated with radionuclides.

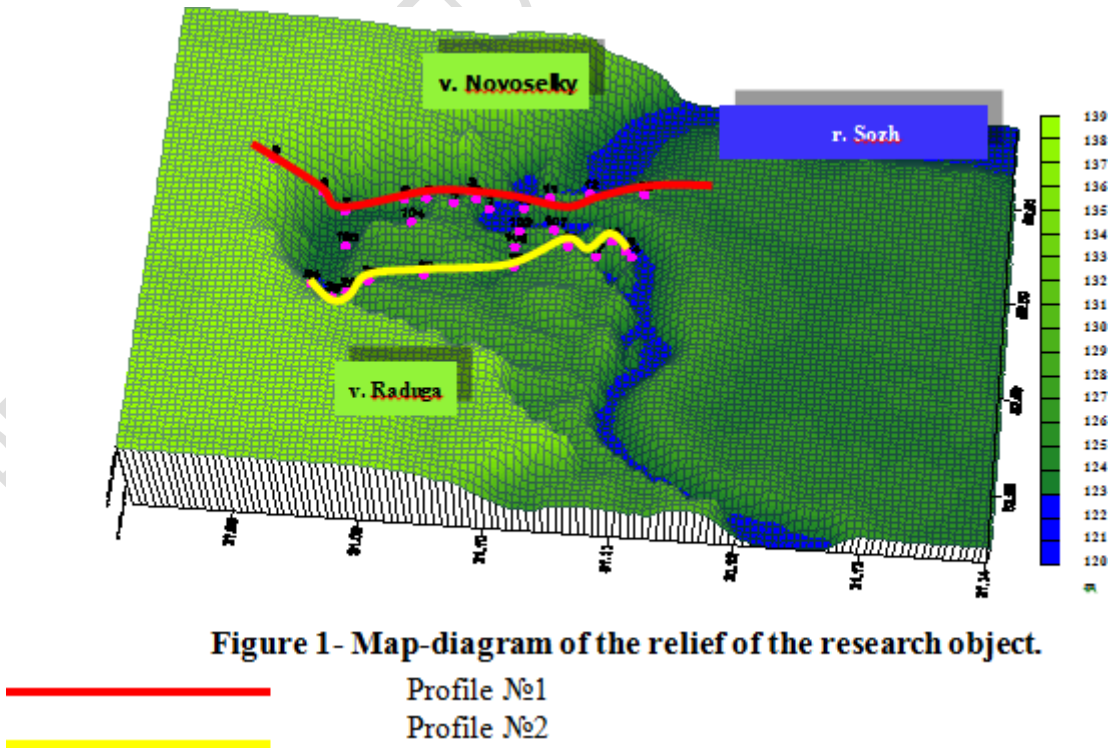

Figure 1- Map-diagram of the relief of the research object.

Figure 1 – Map-diagram of the relief of the research object

The optimal method of selection of the structural parts of the floodplain ecosystem, as well as the spatial estimation of the distribution of radionuclides taking into account relief features, is the construction of relief maps using GIS technologies based on topographic surveying of geographic coordinates and altitudes above sea level and the subsequent imposition of radioactive contamination fields. GIS technologies combine traditional operations of databases application, such as query and statistical analysis, with the benefits of full visualization and geographic (spatial) analysis that the map provides.

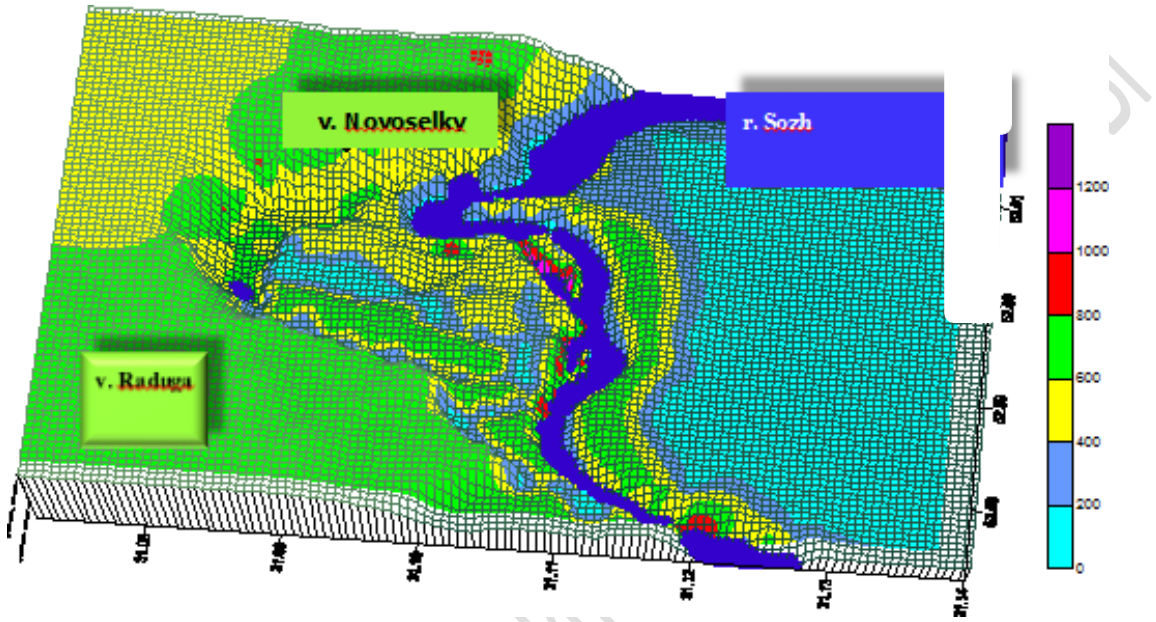

Figure 2 – Relief map-scheme of contamination density of ^{137}Cs of the soil of the research object, kBq / m^2

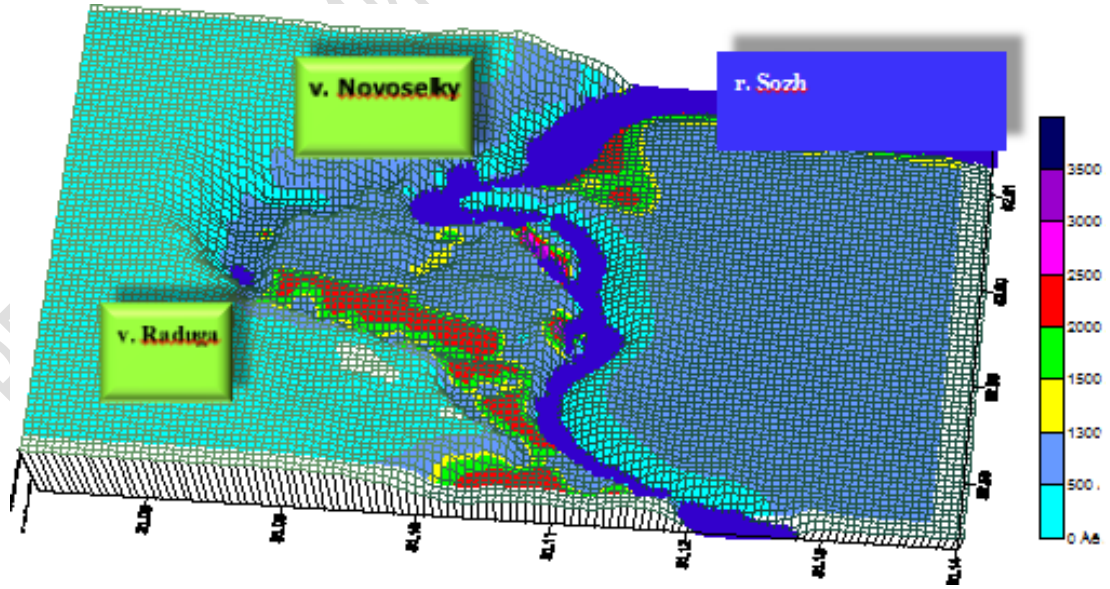

Figure 3 – Relief map-scheme of contamination of ^{137}Cs vegetation of the research object, Bq / kg

These capabilities distinguish GIS from other information systems and provide unique opportunities for its application in a wide range of tasks related to the analysis and forecast of phenomena and events of the surrounding world. The process of creation of GIS-maps is more simple and flexible than in traditional methods of manual or automatic mapping. It starts with a database. The database can be updated with new data at any time and existing ones can be adjusted as necessary [6]. Due to the complexity of the problem of evaluation of the radioecological situation in the territories contaminated with radionuclides in the Republic of Belarus, the issue of applying geoinformation systems as a powerful tool for modeling, database management and visualization of results is topical.

The most important elements of databases for modeling processes occurring in river valleys are information on the distribution, representation, quantitative and qualitative characteristics of radionuclides migration, types and scales of geochemical barriers [7]. It is necessary to intensify the work on the introduction of geochemical methods of floodplain research into the environmental monitoring system and the forecast of radioactivity spread in order to develop practical recommendations on the most optimal use of these landscapes in human economic activities.

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ПРИМЕНЕНИЕ ГИС-ТЕХНОЛОГИЙ ПРИ РАДИОЭКОЛОГИЧЕСКОЙ ОЦЕНКЕ ПОЙМЕННЫХ ЛАНДШАФТОВ

В качестве инструмента для решения радиоэкологических задач и задач, связанных с сельскохозяйственным производством на загрязненных радионуклидами пойменных угодьях, предлагается использовать пространственно-распределенные базы данных и ГИС-технологии. Основу работы составляет анализ более 306 проб растений, 186 проб почвы, 18 проб воды. На

исследуемом участке заложены 2 ландшафтных профиля. Структурно-функциональные части охарактеризованы 24 точками комплексного описания со съемкой географических координат и высот над уровнем моря при помощи спутникового персонального навигатора Garmin GPS12 XL.