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USE OF DIGITAL TECHNOLOGIES IN SOIL SCIENCE

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Annotation: this article presents information about the work being done in the field of soil science, the use of digital technologies in the field.

***Keywords*:** soil science, innovative, digital information, ecology, plant, soil, information, multimedia, model.

Today, the development of various sectors of the national economy of our country, including the field of soil science, cannot be imagined without new innovative directions and developments. The application of innovative solutions in the field of soil science, first of all, the effective use of soils, which are the main link of the agricultural network, maintaining and increasing their productivity, their health, quick and high-quality agricultural land owners service oriented.

Special attention was paid to this direction in the decree of the President "On improving the state management system for the development of scientific and innovative activities" adopted on April 1. In it, priority activities of the Ministry of Innovative Development in 2021-2022 as one of the directions in the field of increasing soil fertility, the establishment of a comprehensive monitoring system of agrochemical, chemical, physico-chemical and ecological-ameliorative conditions of soils, the creation of resource-efficient irrigation and fertilizing agrotechnologies is a solution in the field indicates that there are issues that need to be addressed. Establishing a network of mobile laboratories in the regions, diagnosing the condition of the soil and increasing its productivity are particularly important tasks.

Research in the field of soil science and ecology, as in other natural sciences, is usually associated with the preliminary collection of initial data, its processing, subsequent analysis and visual presentation of the results. The development of technical tools for recording environmental parameters and processes of interest to researchers and the development of software for the specific purposes of these fields of science created the necessary conditions for the modernization of scientific research. new opportunities in working with information. Computer modeling allows conducting digital experiments with virtual objects that pose a threat to real objects, developing forecasts for the development of large-scale situations and proposing measures to minimize their consequences. Geographical information systems (GIS) technologies are widely used in the description, modeling and forecasting of spatio-temporal processes and phenomena, including processes related to environmental protection, which are particularly relevant for humanity. Modern supercomputers make it possible to search for solutions to global environmental problems at a qualitatively new level.

Currently, information technology is rightly classified as the priority directions of science, technology and technology development, which allows us to hope for the emergence of new tools and methods for soil science and ecology research and to expect important results. Computerization of geological research can be described as a methodology based on the use of computers and information-computing technologies for planning and conducting field, laboratory and theoretical work, as well as for summarizing, processing, formalizing and analyzing their

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results. We have many examples of successful use of computerization methodology in the field of soil science and ecology. As an example of specific application of information and computing technologies, let's consider the experience of adaptation and application of computerization methodology in environmental research of the Faculty of Soil Science, Department of Radioecology and Ecotoxicology of Moscow State University. Including large-scale long-term radioecological studies of the consequences of the accident at the Chernobyl NPP are an example of this.

The first attempts to use information and computing technologies in scientific research were made with the appearance of the Department of Remote Terminal Access to the BESM-6 computer of the Scientific Research Center of Moscow State University. This made it possible to engage in mathematical modeling of the biological cycle of carbon and radiocarbon. Models of different levels of complexity were built and implemented in the FORTRAN algorithmic language: long-term (with a step of one year) - study of carbon and 14C dynamics in a small-leaved forest ecosystem, agrocenosis and steppe ecosystem, simulation - seasonal in a snotty oak forest ecosystem (with one-hour steps) to study carbon dynamics. They made it possible. The work was supported by the Russian Foundation for Fundamental Research (grant No. 14-04-00143-a). Determine the parameters of the biological cycle of carbon and the accumulation of radiocarbon in plant and soil horizons. Numerical experiments were conducted to simulate the effects of possible climate changes on production processes in an oak forest. The behavior of radionuclides in terrestrial ecosystems in the 30-kilometer zone of the Chernobyl accident since 1986 and in the adjacent contaminated areas of the Russian Federation fundamental research was conducted and recommendations for damage reduction and environmental forecasting were developed. accident consequences. The main practical task is to assess the possible penetration of radionuclides into groundwater and the level of radioactive contamination of forestry products. In the first two years, it was possible to develop and improve the original methodology for collecting and processing plant and soil samples, which allowed to collect the necessary initial data annually in a single form convenient for digital collection. Further processing through databases and software. First, BESM-6 was used for these purposes, and then they switched to working on personal computers, because their constantly increasing speed and storage resources adequately met the needs of our research and were more convenient in terms of access and computing resources. We use a database management system (DBMS) dBase to collect and analyze data from publications on similar topics, including the initial data needed to create simulation models, and then "EKOLIT" has been created and is working in Access DBMS, the programming environment embedded in the information system. As the appropriate peripheral became available to us, scanning and digitizing printed materials began to be used to supplement it.

UNIDATA STARLOG autonomous system was used for automatic recording of local meteorological parameters that may affect the studied radio ecological processes, the core of which is portable with built-in RAM for collecting and storing data from external sensors. was a programmable device. At the next stage of the study, the sampling sites were connected to the ground using GPS satellite navigation technology. Information on temporary accommodation of expeditions was processed on laptops. A computerized mobile complex "Pro-gress-BG" with an analog-digital converter installed in a docking station for a laptop is designed for carrying out spectrometric measurements.

Land cover and soil profiles were entered into databases, processed, summarized and analyzed using various tables and a specially developed software package created and run in the dBase DBMS programming environment, and then FoxPro DBMS. When studying the spatial distribution of radioactive pollution density in the experimental area established within the

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restricted zone, the data from the databases were also transferred to the SURFER graphic package for visual representation in the form of an isolated or three-dimensional image. This allowed monitoring trends in vegetation components, biogeochemically related landscapes and soil profiles and making short-term forecasts for the next few years. Simulation models of vertical migration of 137Cs in automorphic and hydromorphic soils of forest ecosystems (with a step of one day) and models of long-term dynamics of 137Cs content in tree branches and soil (with a step of one year) for forecasting. Deciduous and coniferous forest ecosystems are built and implemented in the BASIC algorithmic language, the full spectrum of hydromorphism. A modified version of the long-term dynamics model of 137Cs in the pine forest ecosystem was used in the IAEA BIOMASS international research program on radioecological mathematical modeling (1996-2001) with the participation of the department.

In the field of simulation modeling, we should expect the expansion of banks of algorithms and models that describe a wide range of processes occurring in the biosphere in the present and in the past, as well as predict the future of the biosphere in various scenarios. Increasing the speed of common computers for researchers allows creating universal multi-component simulation models of the ecosystem level, taking into account the influence of a large number of factors. The development of such models for the main types of ecosystems is necessary for large-scale projects to build computer models of entire regions, continents, and ultimately the entire planet. Grid technology (Internet-2) is promising and is based on five components: use of open standards, integration of heterogeneous systems, data exchange, dynamic allocation of resources and integration of computer networks of many organizations.

This technology will be in demand, especially in areas that require large computing resources, including solving resource-intensive problems of natural science research, for example, creating global ecological models or working with large-scale geographic information systems in soil science. Along with the computing capabilities of computers, their multimedia capabilities are also in demand. A promising direction of computerization of research seems to us to be further synthesis of mathematical modeling and GIS technologies with visual display tools in the form of a virtual object realized on a monitor screen or in the form of a hologram in three-dimensional space. This may include visual tools in addition to quantitative methods in assessing model adequacy. The most important direction of computerization of scientific research is the introduction of communication technologies. This prevents duplication in research and serves to unite the world scientific community (for example, the project "Digital Bank of European Research" - www.driver-repository.eu). International network conferences are relevant for solving the most important problems of natural sciences. We should expect further integration of satellite monitoring tools and computing technologies for facilities that are the subject of geological and environmental research.

In short, the use of information and computing technologies in solving environmental problems is a necessary research tool that ensures their effectiveness, rationality and economy. An important aspect of computerization of scientific research in this regard is the creation and development of a single information field, which also serves to successfully solve complex environmental problems. Prospects of computerization of soil science and ecology are closely related to the development of new approaches to research based on modern achievements in the field of information and computing technologies, as well as the improvement of computer equipment, necessary peripheral devices, and software.

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