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MONITORING AND ANALYSIS OF CHANGES IN THE ECOLOGICAL STATE OF URBAN SOILS: A GEOGRAPHIC INFORMATION SYSTEMS-BASED APPROACH

The growth of urbanization exposes cities to a number of environmental problems, including heat islands, noise, various forms of pollution (air, soil and water), loss of biodiversity and, ultimately, degradation of urban ecosystems and threats to ecosystem services and human health. Earth observation data and geographic information systems (GIS) are used to study the ecological state of urban ecosystems.

Soil quality assessment includes a wide range of laboratory and remote sensing methods, empirical and theoretical mathematical models for quantitative and qualitative assessment of their ecological state. The application of GIS significantly accelerates data acquisition and comparison, territorial zoning based on identified critical transformations of urban soils, identification of ecological-geochemical instability zones associated with anthropogenic impact. The large volume of experimental baseline soil characteristics makes databases a useful information source for optimizing mathematical models for predicting urban soil transformation as a result of anthropogenic impact under conditions of transport and industrial load.

Modern soil property databases are organized sets of records presented in the form of tables and associated auxiliary files. They are maintained by a database management system (DBMS), which allows creating, modifying existing and deleting unnecessary records in the database, executing queries to retrieve and process data, ensuring data integrity, and controlling data access. In the field of database development, a crucial step is the integration of spatial or attribute data into the system. This process typically begins with the collection of spatial data by government agencies responsible for monitoring and analyzing land use patterns within a defined study area. Given that spatial data often comes in a multitude of forms and formats, a key stage is the standardization of this data to ensure uniformity and compatibility. To illustrate this critical preparatory stage, a flowchart is used, as shown in Fig. 1, to visually represent the sequence of operations required for effective spatial data processing.

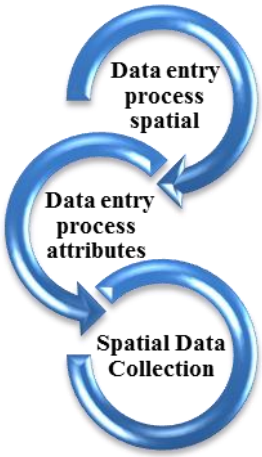

Fig. 1. Data collection process

The use of GIS software, particularly ArcMap version 10.4, plays an important role in facilitating the input and management of attribute data that typically accompanies spatial information. Digital format data often contains many attribute details. It is at this stage that data goes beyond simple geographic coordinates to embody a richer and more detailed representation of soil characteristics. Careful data curation ensures that all information entered into the GIS database is consistent, accurate, and ready for further analysis.

The conducted systematic analysis of the geo-ecological state of urban soils in Cherkasy city using GIS allowed identifying the beginning of its significant changes, determining zones of development of dangerous exogenous processes and ecologically-geochemically unstable ecosystems. The creation of a database (Fig. 2) and cartographic models of city soil properties for monitoring their spatial-temporal changes opens new opportunities for implementing an effective monitoring system using modern GIS technologies.

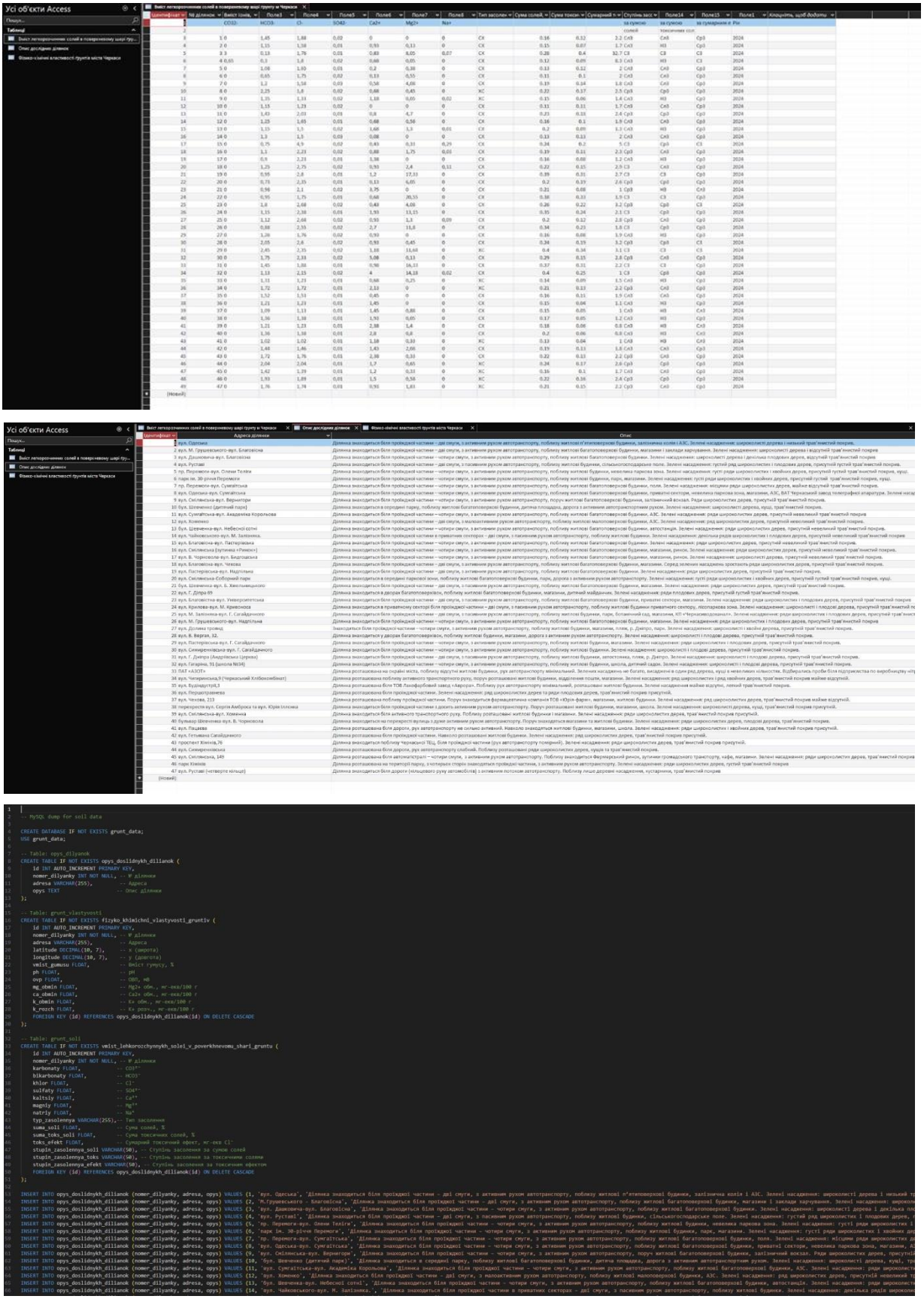

Fig. 2. Database files

The proposed urban soil monitoring system will contribute to the development of effective environmental protection measures for the city and its sustainable development.