Extensible of Measuring Result of Points Samples of Hungarian Soil Information Monitoring

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Abstract

The Soil Information Monitoring System (SIM) covers the whole country and provides opportunity to create similar information systems for the natural resources (atmosphere, supply of water, flora and biological resources etc.). The aim is to relate these databases. The SIM territorial measuring grid consists of 1236 measuring points. These points are representatives. Distribution of the points by soil types represents the variety of soil types of the country.

In consequence of the EU accession, the particular and objective survey of current soil condition is a very important question, which can be the beginning of the implementation of the modern agrarian environmental management programme. This survey is not much use if the change of condition cannot be investigated continuously in systematic interval.

On the basis of the above mentioned point of view decision was born on creating the planned National Environmental Protection Information and Monitoring System. The first working subsystem was realized as the Soil Information Monitoring System (SIM) module.

On a statistical based developed system can be a suitable information system for the management determining the element concentrations in a well-defined precision. To determine the concentration of the elements, need only the GPS co-ordinates of the place.

The aim is to create an information system of the above-mentioned statistical analyses of the submitted samples. The data can access by a suitable authority system. The supervisor can insert, delete and modify data, the singular user can make queries from the database by SQL technology. The singular users will need an Internet Browser programme only to see the data and create queries.

Key words

EU accession, Soil Information Monitoring System (SIM), Database on the Internet.

Soil Monitoring in Europe

Soil Monitoring is one tool to provide soil information. In Europe there are a variety of initiatives that have been developed aiming at the collection of soil information. Collection of soil information in Europe can be classified into three categories (MONTANARELLA 2003):

- Soil Mapping, providing information on distribution of soil types and enabling to identify areas of land suitable for certain management purposes;
- Soil Inventory, providing an assessment of soil conditions and/or properties at a point in time;
- Soil Monitoring, providing a series of assessments showing how soil conditions and/or properties change over time.

Two soil monitoring programmes exist at the European level, which are part of the international cooperative programme on assessment and monitoring of air pollution effects on forests (ICP Forests) (BLEEKER et.al., 2003; ERISMAN et.al., 2003) and of the international cooperative programme on integrated monitoring (ICP IM) (KLEEOMLA and FORSIUS, 2002).

The Integrated Monitoring network currently covers some 50 sites in 21 countries.

Since 1995 the European Environment Agency (EEA) has published a number of “state-of environment” reports where assessments of the state and trends in Europe’s soil and soil degradation issues are regularly reported. In 2001, the EEA published a technical report on ”Proposal for a European soil monitoring and assessment framework” (EEA Technical report 61; EEA 2001). This report includes an appendix on „Existing soil monitoring networks and databases“. It summarizes the main results of a questionnaire regarding national soil monitoring activities across Europe distributed to the 18 EEA member countries and Switzerland. Overall results indicate that a large number of soil information is available, and that soil monitoring networks have been established in a number of European countries for regular recording of soil changes.

Soil Monitoring in Hungary

A large amount of soil information are available in Hungary as a result of long-term observations, various soil survey, analyses and mapping activities on national (1:500,000), regional (1:100,000), farm (1:10,000-1:25,000) and field level (1:5,000-1:10,000) during the last sixty years. Thematic soil maps are available for the whole country in the scale of 1:25,000 and for 70% of the agricultural area in the scale of 1:10,000.

There are at least three reasons why this rich soil database has been developed (VÁRALLYAY, 1993):

- the small size of the country (93,000 km²)
- the great importance of agriculture and soils in the national economy
- the historically "soil loving" character of the Hungarian people, and particularly the Hungarian farmers.

In the last years all existing soil data were organized into a computerized geographic soil information system, which consists of two main parts:

- The soil data bank, including 3 different types of information:
    - basic topographic information (geodetic data standards)
    - point information (measured, calculated, estimated or coded data on the various characteristics of soil profiles)
    - territorial information (1:25,000 scale thematic maps) and soil properties.
- The information system, including models on moisture and plant nutrient regimes of soils; susceptibility of soils to various soil degradation processes, etc.

The Soil Information and Monitoring System (TIM) is an independent subsystem of the integrated Environmental Information and Monitoring System (KIM) (TIM SZAKÉRTŐI BIZOTTSÁG, 1995).

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In consequence of the EU accession, the particular and objective survey of current soil condition is a very important question, which can be the beginning of the implementation of the modern agrarian environmental management programme. This survey is not much use if the change of condition cannot be investigated continuously in systematic interval.

On the basis of the above mentioned point of view decision was born on creating the planned National Environmental Protection Information and Monitoring System. The first working subsystem was realized as the Soil Information Monitoring System (SIM) module.

Based on physiographical-soil-ecological units, 1236 "representative" observation points were selected (and exactly defined by geographical coordinates using GPS). There were 865 points on agricultural land, 183 points in forests and 189 points in environmentally threatened "hot spot" regions. The latter represented 12 different types of environmental hazards or particularly sensitive areas such as: degraded soils, ameliorated soils, drinking water supply areas, watersheds of important lakes and reservoirs, protected areas with particularly sensitive ecosystems, "hot spots" of industrial, agricultural, urban and transport pollution, military fields, areas affected by (surface) mining, waste (water) disposal affected spots.

Result

In the first step, we are choosing a point as Unknown – U (of course we have measured concentration of the elements, but we consider as unknown). Later we are comparing the calculating and the measured concentrations and calculating relative difference. A Visual Basic programme is determining the distances the Unknown - U and the Known - K points and sorting by distance, that’s way easy to choose the nearest points. In the next experiment the next point will be Unknown - U and so on, while reaching the last point.

The difficulty to determine how many known points are considers. Evaluating the number of these points is necessary several different statistical methods. After this method we have the number of nearest neighbourhood points in every element. These numbers are stored in the database.

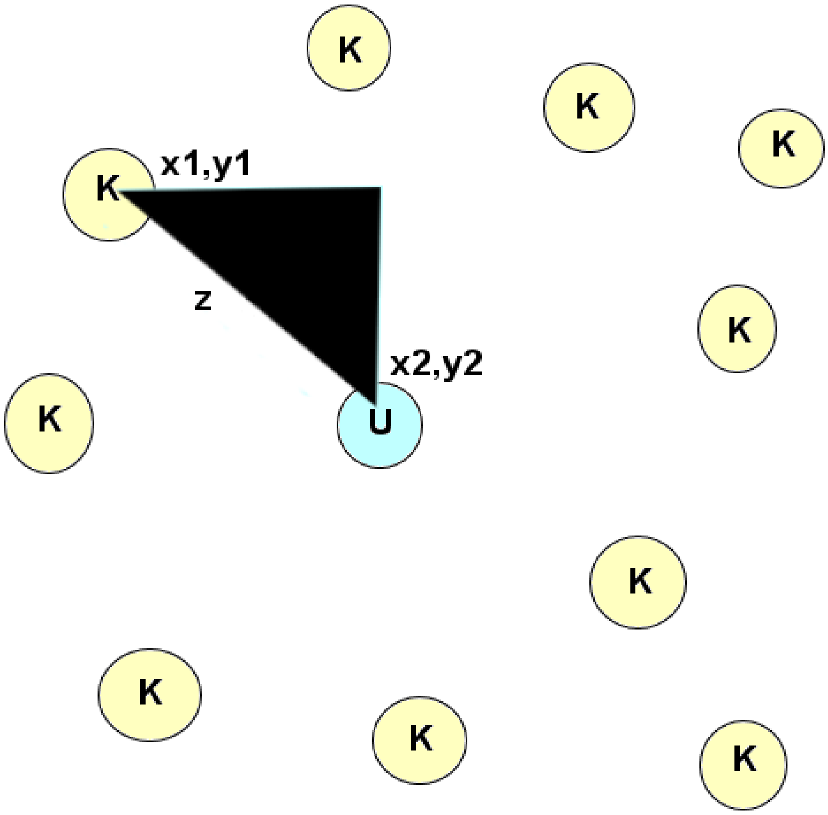

Fig. 1. K = Known measuring points (x1,y1: co-ordinates of place)
U = Unknown measuring point (x2,y2: co-ordinates of place)

The distance of the K – U can be determined from the next equation by the pythagora's theorem:

$$Z = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \qquad 1.$$

If the distances are determined for all points, are chosen the 10 least. These distances are z1, z2, z3, ……, z10. From these distances and element concentrations of the ”Known measuring points” can be calculated the given element concentration cx by using mixing equation.

$$c_x elem = \frac{1/z_1 * c_1 + 1/z_2 * c_2 + ... + 1/z_i * c_i}{1/z_1 + 1/z_2 + ... + 1/z_i} \qquad 2.$$

If we have the determined cx it can be compared to the measured concentration value and calculating the difference between the measured and determined concentration. In these data can be calculated the deviation of the concentration of the given element. These steps have to repeat for the other elements for this ”Unknown” point and after for the other points.

$$M = \frac{100 * Sz}{\pm E + 100} \qquad 3.$$

where: *”Sz” the calculated concentration,*
”E” the relative error
“M” the concentration in the unknown point

If these steps are ready, we have concentrations of the elements for these points and the deviations. In the database we have the GPS co-ordinates of these points, that's why if somebody need information about the concentrations of elements he has to know only the GPS co-ordinates of the given point and can get it.

In Figure 2. can be seen a simple PHP-form., where the users can ask the concentration of elements based on the GPS-co-ordinates.

The authority system is a very important question in every database. In this experimental phase are created only 2 users, one of them is the database administrator (supervisor), the second one is a singular user, who can ask the concentration of the elements based on the GPS-co-ordinates.

Fig. 2. PHP form to evaluate the concentrations and reliability of the chosen elements based on the GPS-co-ordinates

On a statistical based developed system can be a suitable information system for the management determining the element concentrations in a well-defined precision. The element concentrations were measured by ICP-OES spectrometer by the University of Debrecen Centre of Agricultural Sciences. To determine the concentration of the elements, need only the GPS co-ordinates of the place. In the later phase we are preparing a map of Hungary, where can be chosen the place by clicking of the mouse. This method is much more user-friendly.

The aim is to create an information system of the above-mentioned statistical analyses of the submitted samples. Data can access by a suitable authority system in this information system. A group can insert, delete and modify data, another group can make queries from the database by SQL technology. The information system will operate in a client/server architecture. The access will be provided by the Internet/Intranet technology, which means, that singular users will need an Internet Browser programme only to see the data and create queries.

If statistical processing of the measured results of the entire county is completed and entered into the database, users can use these information in their strategic decisions, as well

The aim of the statistical analyses of the submitted samples to create an information system. Data can access by a suitable authority system in this information system. A group can insert, delete and modify data, another group can make queries from the database by SQL technology. The information system will operate in a client /server architecture. The access will be provided by the Internet/Intranet technology, which means, that singular users will need an Internet Browser programme only to see the data and create queries.

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