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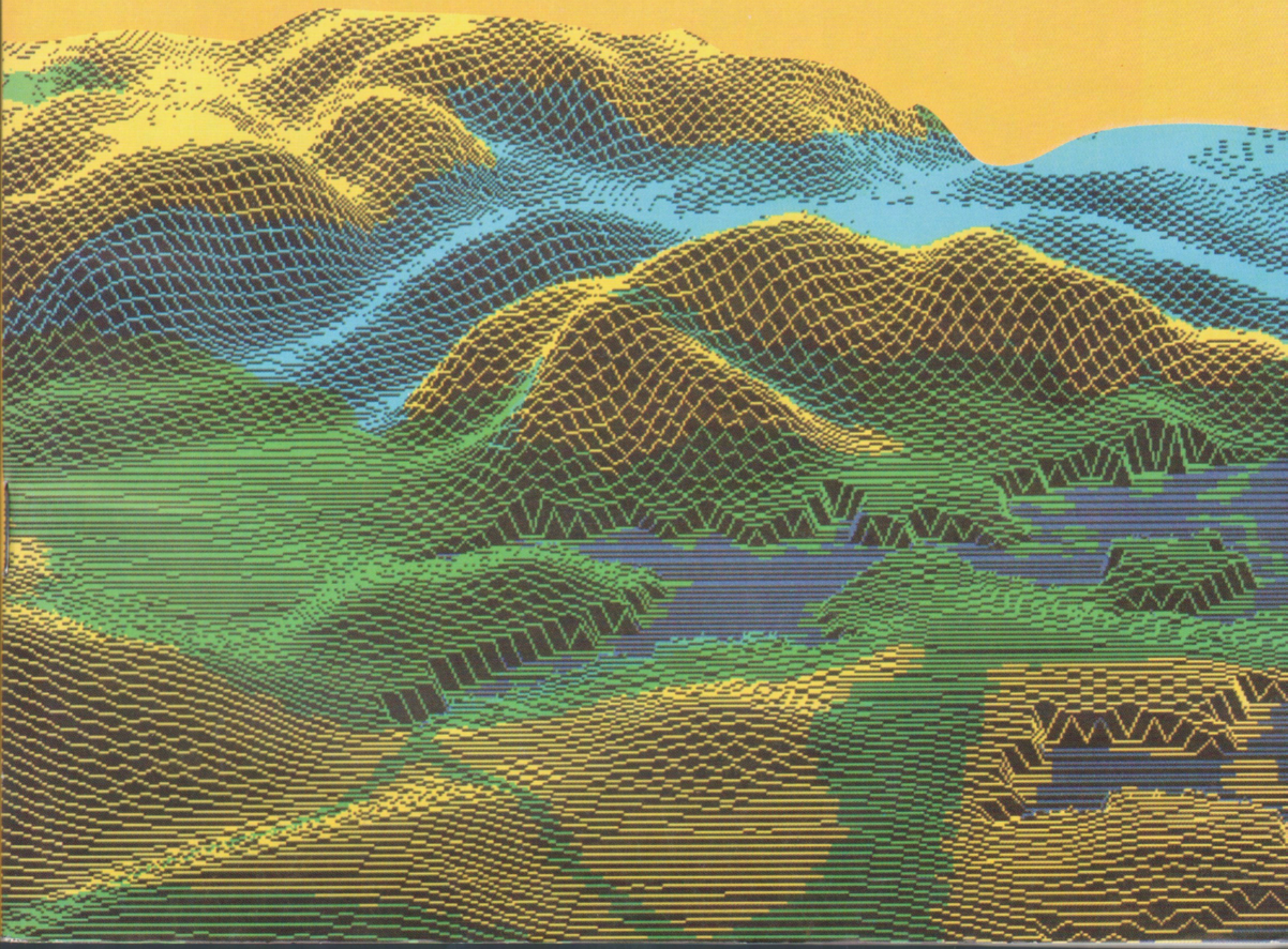

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ENVIRONMENTAL GEOINFORMATION SYSTEMS AND POST-ACCIDENTAL TERRITORY MANAGEMENT (KYJOV TOXIC ACCIDENT CASE SITE)

Jaromír KOLEJKA - Jan POKORNÝ

Summary

A local purpose oriented GIS has been developed as a post-accident territorial management system for hazardous production/storage sites. The GEORISK Knowledge Base GIS is a common product of the Institute of Geonics, Branch Office Brno, and Masaryk University in Brno. The GEORISK GIS contains separate four sets of the text, legend and map data files and processed satellite image of the area under study. Each of the sets is composed of information about the selected component of natural environment, about behaviour of pollutants within the selected component, and about measures required in order to remediate the territory. The GEORISK system is a user-friendly tool, and the data sets and some files can be linked by simple operation of the mouse.

Shrnutí

Environmentální geoinformační systémy a pohavarijní řízení území (případ toxické havárie u Kyjova)

Lokální účelový geografický informační systém byl vyvinut pro potřeby pohavarijního řízení území v prostoru rizikových výrobních a skladovacích lokalit. Systém GEORISK vybavený expertní poznatkovou základnou je společným elaborátem Ústavu geoniky v Brně a Masarykovy university. Systém obsahuje čtveřice základních textových, legendových a datových souborů, doplněných pomocnými datovými a textovými soubory a družicovým snímkem velkého rozlišení pro orientaci v zájmovém území. Každý soubor obsahuje informaci o dané přírodní složce prostředí a o opatření na omezení důsledků pobytu polutantu v této složce. Ovládání systému je velmi jednoduché. Uživatel vyvolává postupně nebo podle potřeby jednotlivé informace pomocí menu a práce s myší.

Key words: GIS, environmental applications, toxic hazard

1. Introduction

Many failures of industrial plants, chemical warehouses and nuclear power stations , which occurred recently suggested that what is practically missing is the entire area documentation to detect pollution spread, migration of pollutants, operative and planned rescue measures in the landscape as well as prognoses on further development of contamination in the natural and anthropogenically differentiated landscape. Landscape is an active and at the same time also passive participant to the possible accident. With a whole set of its structural and dynamic properties it performs influence on primary and secondary distribution of pollutants, their migration, concentration and dilution. Documentation about such a landscape that could become subject to possible accidents should include not only factual material, guidelines on how to use it, possibly also software for real-time operative evaluation and modelling, but also proposals of localities for permanent and post-accident monitoring, or regionally differentiated measures. Operative utilization of these data cannot be thought of without application of geoinformation systems (GIS). GIS is understood as a system of humans, technical and organizational means making data collection, transfer, storing and processing to get territorial information (according to IGU, in Konečný, Rais 1985). In comparison to other information systems, the GIS treat localized data (Aelders 1980).

The experience gained so far on measures in the case of an accident often show how helpless the bodies of civil defense can be, how their activities can many times be inadequate and incompetent both at the time of immediate danger and particularly after the accident since there is neither sufficient plannary monitoring of area contamination nor possible forms of pollutant integration with environment. Rescue operations take long time because research in localities of these hazardous production plants or stores is usually made ex-post, which means that necessary area data are lacking with a few exceptions only corroborating the rule.

2. Application of GIS at environmental management

Environmental data are only exceptionally included in common territorial information systems at present time. Importance of these data markedly increases in GI systems concerned with management of natural resources or natural hazards. Definition of the "environmental data" can be considerably wide. What can generally be considered data on environment are informations which describe or assess actual or potential effect of human activities or rapid natural processes on life and work of the man, quality of environment, equilibrium in the landscape, and biodiversity.

The simpliest task of these environmental data is to be a part of a description block of data on the GIS-concerned area. In this case, the lump or multitemporal data can be products of inventory or environment monitoring, being stored in GIS as a documentation material (Smart 1986, Treitdal 1991, McDonald, Smith 1991). These cases of position of the environmental data in geoinformation systems include information on land use and its chronological changes, a.o. on localization of dumps, landfills or other sources of contamination to environment (transport arteries with traffic census), protected landscape areas, etc.

The data on environment become much more important in the GIS which are concerned with both simple and more complex assessment operations aimed at judging suitability or environmental risks in the areas of interest. In many a case, environmental interpretation of various data is used for thematic assessment of the area (Webster, Siong, Wislocki 1989, Estes, McGwire, Fletcher, Foresman 1987, Sauchyn 1989, Haber, Schaller 1988, Caron, Merchant 1986, Lamont 1991, McDonald, Smith 1991, SHasko, Keller 1991, Taylor, Ullman 1993, and others). The environmental data explained in this way serve at decision-making processes for environmental territorial management.

Key role is being played by environmental data in those geoingormation systems which are purposefully focused on integration of more environmental phenomena and their spatial and time modelling. This modelling is usually directed at development of some rapid processes and accidents, most frequently fires (fire management), spread of diseases in forest stands, forest succession etc. (Knutson, Douhan 1991, Wertz 1991, Van Wagtendonk 1991, Kessel, Beck 1991, McRae, Cleaves 1991, Polzer et al. 1991, Pamap 1993), possibly also at growth or decline in numbers of animals from certain areas at contamination of environment (Mueller 1991). Simulation models of the processes serve as a certain form of scientifically based prognoses of given phenomena. Another example of modelling can be a computer analysis of optimum land use or at least its stabilization or protection framework (Dick 1991, Kolejka 1992). For modelling purposes the environmental data must be selected and treated by specific methods and have to also be verified at random during their processing by comparing results from partial stages of modelling with empirical figures.

A special case of environmentally specialized geoinformation systems are information systems of national parks and other protected areas. Data stored in them can play informative, assessing, modelling and/or predication roles. However, the GIS on national parks can exhibit dominance of environmental data files only after several years of their building (Haskell 1991, ScotT et al. 1991, Okafor 1993).

3. Models of using GIS on the basis of territorial differentiation of risks

Risk status of individual sites in the area, or hazard for human beings to dwell in these sites, is a subject of some specialized territorial information systems. With regard to the fact that in addition to basic or purposefully modified information about the area they usually contain the text documentation and guidelines for their use including description of methods of how to reach certain results, they generally conform with criteria for their ranking among expert systems. By approach to the given issue as well as by qualification standard of final user four principal models can be distinguished of geoinformation availability in risk localities of all kinds. The four models are as follows:

1. MULTILAYER BASIC INFORMATION FACILITY
   Information models of this type are represented by GIS with digital maps of those environmental factors that were considered relevant for the given problem by their designers. It is usually a systemic sequence of maps (including accompanying text) which are to introduce the given issue to the user, to make the user acquainted with the area, its features, to create spatial conception about parameters or objects in the area, which can be important (from the viewpoint of the designer) for decision-making in risk situations. The digital map file with expert instructions and guidelines is modified in such way that it is easy to be used for anybody with no computer knowledge but equipped with sufficient experience in the given (risk) issue. Decision making is left to the user who is responsible for sorting out the system of presented information and integrate the data into a document for several variants of solution to the accident or another risk situation. The systems like these were set up for various purposes starting with defence of the population in the case of both civil and war nuclear disasters (Roger, Stella 1990), danger to inhabitants caused by toxic failure such as at production, storage or transport of toxic substances on an example of urbanized areas (McMaster 1988, Harris et al. 1991), or danger to inhabitants caused by

industrial air and water pollution (EPA study for the area of Chattanooga, Tennessee, USA).

2. MULTILAYER ASSESSMENT INFORMATION FACILITY
Information models of this type include already not only basic documents prepared by experts and instructions on how to use them, but also their purpose-oriented interpreted versions. The purpose-oriented GI systems of this type contain basic information about the territory in special digital files, their individual purpose-oriented versions to assess hazard rate of individual areas, objects, sites, phenomena, factors in relation to the source of uncertainty (hazard) in the territory, possibly also proposals for various measures leading to abatement of the hazard prior or post the event. User of such a system is usually a non-expert both in computers and in the given issue but he is rather appointed with executive and implementation roles at corrective measures. The systems of this type present series of electronic (digital) maps with different rates of accident risks both of natural and anthropogenic origin such as lightning, landslides, leakages of troublesome or toxic substances (crude oil accidents both on the dry land and at the coast), etc. (Jensen et al. 1990, Hession, Shankholtz 1988, Lamont 1991, Pearson, Wadge, Wislocki 1991).

3. STATIC ASSESSMENT MODELS follow out of the knowledge of correlations between "conditions", "causes", and "consequences" of risk phenomena in the environment, usually of anthropogenic origin. Systems of this type contain already a sharply separated data base (set of information about the territory) and knowledge base (instructions for how to use the data, what results to expect and how to evaluate them). Data operations are usually based on inquiries presented by the system in order to be instructed for next step while the user can make his(her) choice from many options and make use of the variant that suits best the situation. Proper content of the operations usually consists in generating combinations of thematically differing data in order to either search for certain combinations (threshold values, above- or below-average combinations of factor co-action) or for all actually existing combinations that can further be statistically classified particularly from the viewpoint of learning coherence among the phenomena (e.g. under what conditions a given phenomenon will reach given intensity and territorial extent). This procedure will make it possible to get to territorial projection of accident consequences within certain region (Davis, Whigham, Grant 1988, Sauchyn 1989)

4. PREDICATION DYNAMIC MODELS are based on complicated statistic operations which make use of functional and probability relations between relevant variables, thus introducing the equal fourth dimension into the issue - time. Degree of development in these systems can be very different. The most perfect of them introduce artificial intelligence which can operate instead of the user in certain part of decision making concerning further work proceedings. Nevertheless, the user is still responsible for checking the system operation. The expert knowledge based software is usually formalized empirical experience articulated into elementary relationships, functions and instructions which have accepted a wide range of relevant variables. Time sequence of modelled (static) situations can be kinetized, which will facilitate visual simulation of dynamics of the phenomenon. In some extreme cases, user of the system can be a non-professional with comprehensive knowledge of computing technique. This procedure is used to predict development of relatively very dynamic phenomena such as fires (Estes, McGwire, Fletcher, Foresman 1987, Kessel, Beck 1991, Wertz 1991), migration of air pollutants (models of atmospheric dispersion), that of water pollutants (hydrological models), pollutants in geological environment (geochemical models) with both short- and long-term prospects (ITC, 1993), floods (e.g. near Landesregierung von Steiermark in Graz, Austria).

With no regard to complexity of geoinformation facilities based on GIS, preference is being given to resolution capacity corresponding to the map scale of 1:25 000. This applies both to provision of data and their classification, and to the modelling of risk environmental phenomena within dry-land and water environments.

While the accident plans made in Czech conditions have to more or less adapt their graphical part to "preliminary model assessment of the course and extent of the accident for various cases and meteorological situations", organization of post-accident works is being limited only to research and demarcation of the contaminated territory. Practical consequence of this situation is the fact that there are additional material and financial requirements to collect, treat and pre-process the data, and additional costs that could have otherwise been used to eliminate or reduce consequences of the accident. On the other hand, the measures are often inadequate without thorough knowledge of the area.

4. Survey of tasks to build up geoinformation facilities in risk localities

Principal tasks for the case of implementing a purpose-oriented geoinformation facility in critical localities are as follows:

A) in the area of data base generation:
- definition of extent and size of the area of interest,
- selection and collection of relevant data,
- definition of necessary resolution for the data,

- harmonization or integration of the data.

B) in the area of generating the knowledge base for data management:
- definition of system functions,
- interpretation and purpose-oriented evaluation of relevant data,
- formalization of rules for manipulation with the data,
- determination of forms for demonstration of both initial and processed data,
- choice of demonstration means.

5. Consequences of toxic accidents and the need of geoinformation ensurance at sanitation works

Experience in how to generate a purpose-oriented GIS can best be gained on the case of an actual toxic accident. In the last 20 years there were many toxic and the like accidents which resulted in immense damages to environment and health (Table 1).

The leakages were recorded both in manufacturing plants and in warehouses whose surroundings were affected with toxic substances or increased radioactivity (Budský, Doležal 1989).

Whilst operational measures during the accident concerning rescue of human lives and properties are mostly well mastered, the post-accident measures are not prepared properly. Post-accident documentation studies are usually brought to end long after the event since all data are collected and processed much later.

6. Experience from the toxic accident in Kyjov-Boršov as a starting point for the compilation of a local GIS

One of instructive accidents happened in south Moravia (Fig.1) on 3 - 4 January, 1988 with basic sanitation to 5 January, 1988) in a warehouse of agricultural chemicals belonging to Agricultural Supplies and Purchasing at the village of Boršov agglomerated with the town of Kyjov at the distance of some 3 km from the town centre (Křivák 1988). Regarding the fact that there was no awareness about location of the warehouse, the fire brigade arrived to a completely different place because report on the accident was not accurate enough, which resulted in delayed fire eliminating works. Fire-extinguishing means had to be delivered to the fire including water from a fire hydrant in the 3 km distant town. This means that technical facilities for the case of fire were not paid enough attention in the warehouse. The decisive fire-extinguishing means was water with excessive water amounts infiltrating into the soil, draining away or changing into vapours.

The fire damaged some 150 MT of various chemicals which included organophosphates and other toxic substances. Further noxes were generated as products of interacting burning substances (Rosický, DoleŽal 1988). The majority of chemicals were not properly stored in the warehouse. A smoke cloud or fog came into existence at inversion stratification of the atmosphere at about 2.00 o'clock, being ca. 2 km wide and 20 m high. This cloud of irritating gases spread along the valley bottom and proceeded southwards to the town of Kyjov at the rate of 1 to 1.5 m.s-1 being later as long as some 5 kilometers. Composition of the cloud probably included also sulphurylchloride and chlorsulphuric acid, which both are known by their strong smoke effects and are harmful to human health. At the place of fire itself organic compounds of phosphorus, hydrogen cyanide, chlorine, hydrogen sulphide and other current products of combustion were detected.

Front end of the thick cloud reached northern limits of Kyjov. It was necessary to evacuate children from kindergartens as well as those from immediately endangered primary schools. Later the fog began to dissipate passing through western parts of Kyjov and reaching southwards as far as Dubňany in diluted form.

In terms of setting up a geoinformation system, the gained experience can be classified in several groups:

A) course of the accident:

1-Toxic substances were released due to accident in a relatively common object.

2-The area was contaminated by toxic fall out and polluted waters.

3-Places with stored toxic chemicals in the area had not been subject to inventory, a detailed information on their layout in the warehouse was missing.

Table 1: List of toxic accidents (by various authors, complemented)

Place	Year	Released substance	Persons killed	Persons injured	Affected area km^2
Potchefstron	1973	amoniak	18	?	n.1
Flixborough	1974	cyclohexane	28	?	n.1
Seveso	1976	dioxin	-	n.100	n.10
Bhópál	1984	MIC 2	2 500	n.1000	n.100
Chernobyl	1986	U235	35	n.10 000	n.1000
Kyjov	1988	toxic smoke	-	n.100	n.10
Tomsk	1993	U235	?	?	n.10

Fig.1: Position of the Kyjov toxic accident area in the Czech Republic

4-Actual storing of the chemicals was incompetent (is this usual?).

5-Fire safeguard measures were absolutely insufficient (fire-extinguishing means and water were missing).

6-Data on levels of some substances in environment prior the accident were missing for the purpose of comparison, status of the territory was not known.

B) adopted conclusions:

1. It is necessary to ensure long-term post-accident monitoring particularly that of underground waters and water courses (tap water).
2. Monitoring of adjacent lands to be made in neighbourhoods into which the fire-extinguishing water was drained.
3. Mathematic procedures to be worked out for modelling chemical leakages.
4. Deposition to be ensured of post-accident overburdens, residuals etc. including contaminated soil.
5. A board of experts to be established at governmental level, which would specialize in chemical accidents.
6. To ensure awareness and preparedness of population in the surroundings of risk localities.
7. To instruct manufacturers to add instructions for use and handling their products in the case of explosion or fire.
8. A statement that similar accidents could occur at any place in the country.
9. Detailed accident plans to be elaborated (yet, the proposal of binding content does not include any obligations to become familiar with natural condition of the territory).

Many similar pieces of knowledge, which were recognized to be relevant to the scope of GIS, have considerably influenced appearance of the system, its structure, construction and functions the example of the given area not being the only reason.

7. Case of the geoinformation ensurance for the locality of Kyjov-Boršov

7.1 Natural background of the locality

The area under study is of elongated shape at length and width of 12 and 7 km, respectively and it includes the Kyjovka river valley from southern edges of Chřiby Mts. up to the northern margins of local outlets of the Dolnomoravský úval its width reaching neighbouring valleys of Kyjovka river tributaries which were not affected by the toxic cloud (the main cloud was neither dispersed nor displaced into the neighbouring narrower valleys) but partially afflicted with vapours after the fire had been localized that related to the change of atmosphere (Fig.2). Eastern and western edges of the territory under study follow in fact the high watershed topography of these small valleys against more distant water catchments. The area of 84 square kilometers should be sufficient for the case of planning sanitation measures.

The geoinformation system under construction will assist to ensure the post-accident provisions, and is not meant to model the course of the accident or the spread of pollutants. This issue has usually been neglected.

7.2 Choice, assessment and purpose-oriented interpretation of basic information documents

Available data are subject to assessment from the viewpoint of their purpose within the GeoRisk system. Their interpretation consists in prediction of pollutant behaviour in individual landscape "spheres" of the given territory.

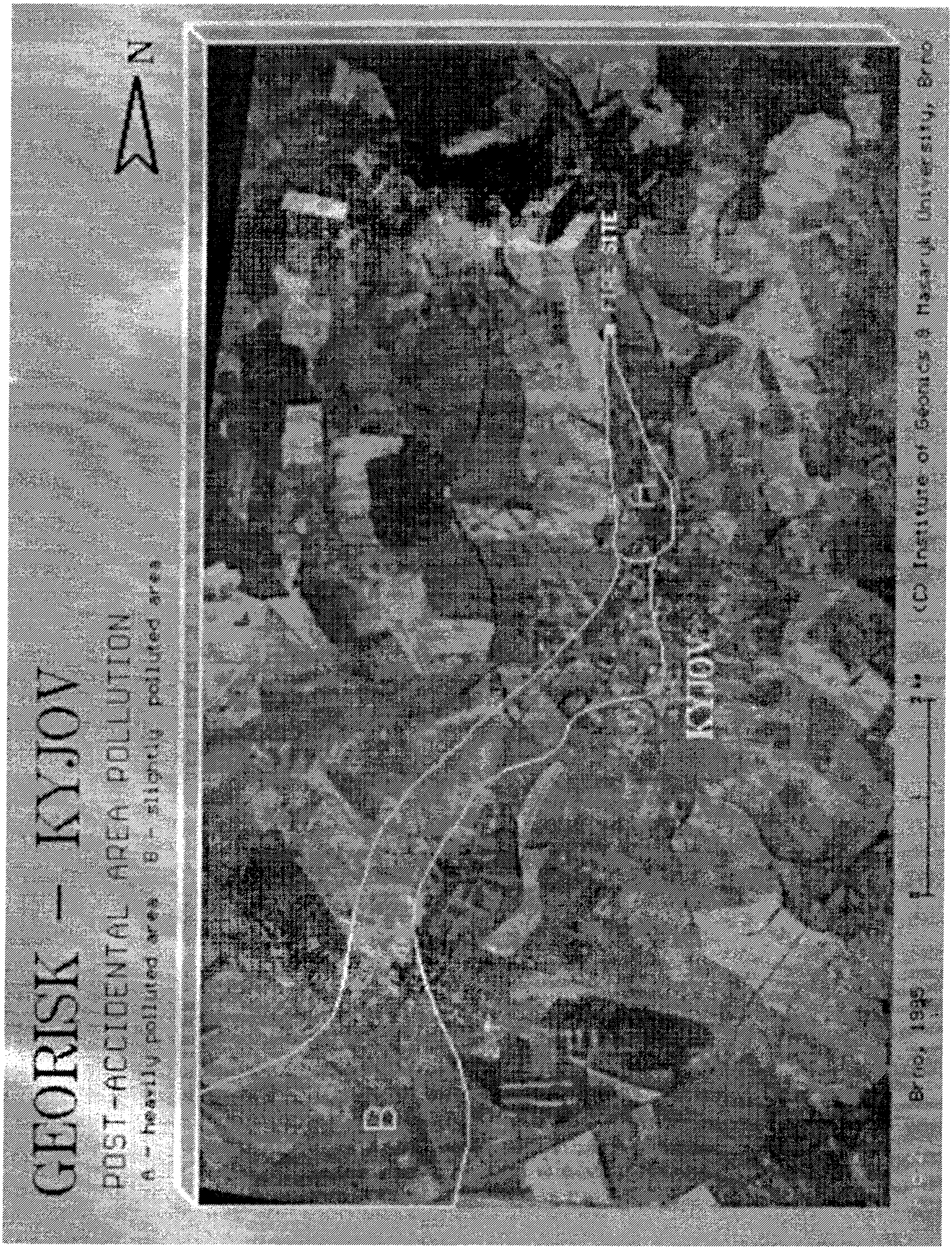
Following data were collected and considered irreplaceable in order to cover spheres of possible migration of pollutants in terms of available information:

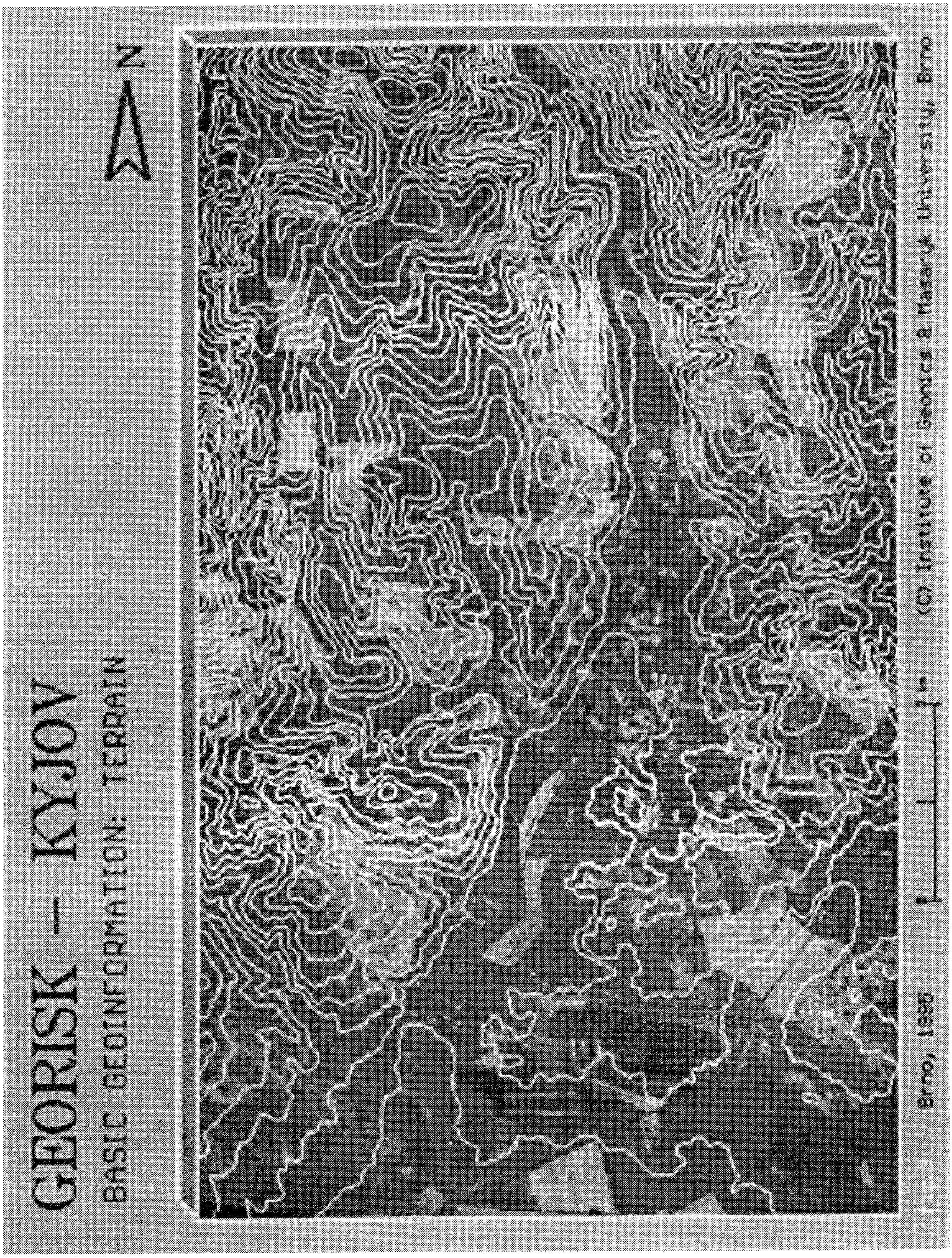
1. for the sphere above the Earth surface - the land use map. However, it showed that the land use map would always follow out of old and with the fire asynchronous information. Moreover, some of the data can exhibit very short life (agricultural crops, buildings). By experimenting with aerial and satellite images it has been found out that as to the content, most acceptable would be the satellite photographs of high resolution. The above-surface sphere is best represented in the system of high resolution satellite photography (Fig.2) that can well inform about the surface cover with biomass, which is important from the viewpoint of general estimates concerning retention function of the plant (and other) cover for pollutants. In addition to all this, satellite imagery facilitates a far better orientation in the terrain than a current map since it contains considerably more information. In the present version of GeoRisk system, major task of the image is to enable orientation within the terrain at learning, assessing and decision-making operations.
2. for the Earth surface - which is best represented by a digital elevation model. Its role in the system consists in generating three-dimension models of the area in order to acquire better ideas about the situation and definition of inclining line aspect at any point of the area under study. Information about topography can also be represented in the system by a mere map of contour lines (Fig.3) and slope areas. The slope areas in three categories of 0-3^{o}, 3-15^{o} and above 15^{o} assist at estimating the rate of pollutant superficial motion.
3. for the soil environment - which is best represented in maps of soil species (mechanical composition and particle-size distribution of the soil) and in maps of soil types (processes in the soil). Particle-size distribution informs about permeability rate of the soil for water as the major transport medium of pollutants and about nature of this motion (filtration-seepage-flow). Typological information provides general relation of the soil to subsurface water (water table movement, periods of incidence near the surface) and water regime (leaching regime means greater danger to subsurface waters in geological environment than evaporization regime with pollutants being prone to generation of secondary cummulations on the soil surface or in its vicinity).
4. for the geological environment - This is described in the screened geological map with important for the motion of pollutants being namely mantle formations and structure of parent rock. An important characteristic of the mantle formations is their mechanical composition which can distinctly affect entrance of the pollutant into deeper layers as well as its further migration especially if its transporting medium is water or the pollutant itself is liquid. In solid substratum, however, the decisive importance is that of bedrock water (liquid) permeability potential which is given both by particle-size distribution of the rock, sealing rate and rate of tectonic disturbance.

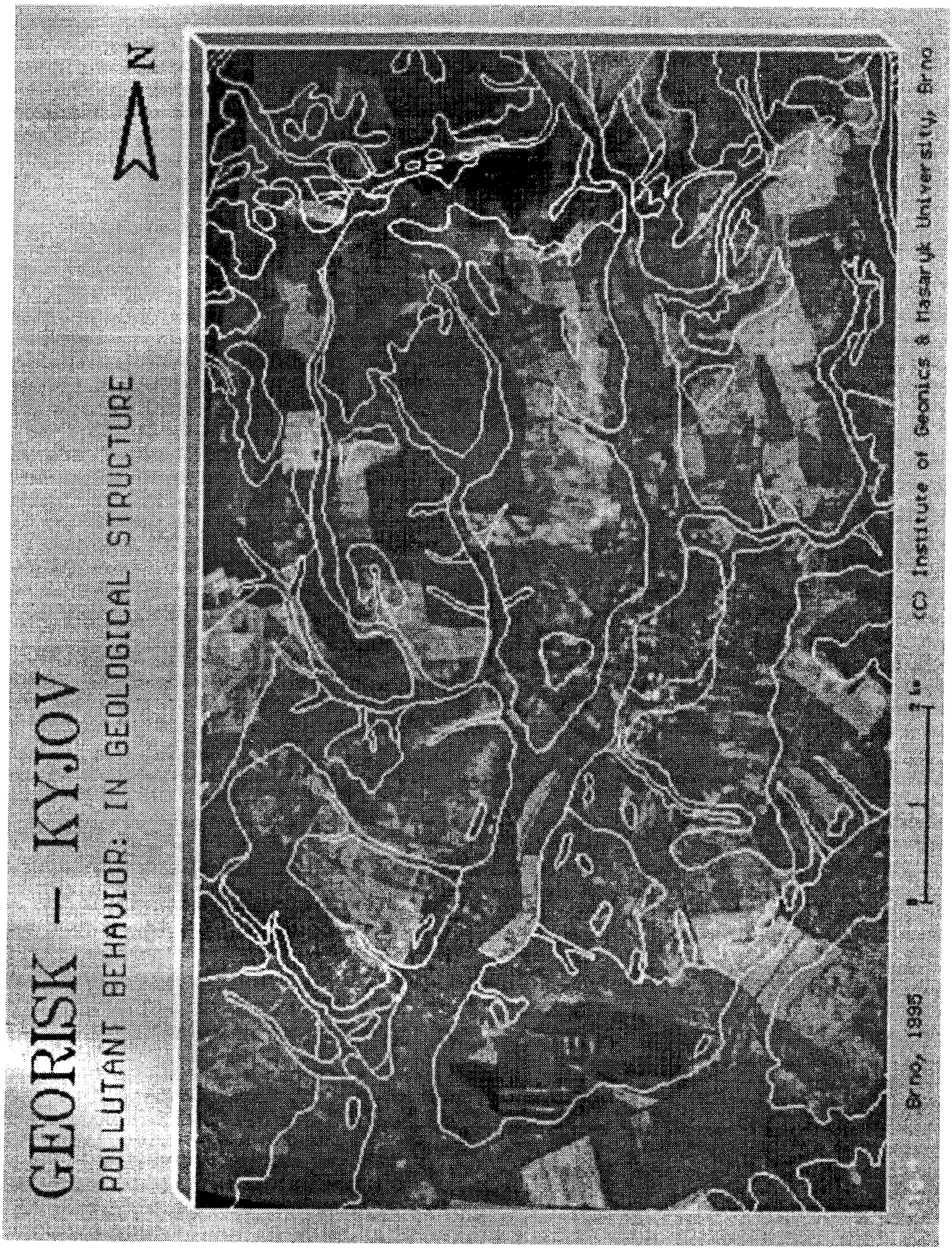
Additional information on the river network and roads serve to immediately control field works. Knowledge of the basic communication network is necessary for decision-making about access possibilities of machines, communications could later be also subject to decontamination. The GIS included contours of the toxic cloud formed during the accident as well as the area of impacted territory (Fig.1).

Methods and results of interpreting fundamental data are adapted into the text form accompanying each of the maps. This concerns description of the character of the elements being mapped by topics (soil, geological substratum, impact of topography) and by the reason for selection of sanitation measures.

The greatest problems are caused by classification of behaviour of various pollutants in environment, or within individual components of this environment. There is no sufficiently detailed knowledge at present, which would describe interactions of individual pollutants with individual kinds of environment (see Fig.4). Therefore, there cannot be any other possibility of resolving this task than to attempt at interpreting behaviour of the decisive transporting medium of the pollutant. This simplification is sufficient to organize sanitation works in the field, which should ensure safeguard over decisive masses of the pollutant in the environment. However, the information about the pollutant can affect - both in detail and conceptionally - the decision-making processes at controlling sanitation works if producer of the chemical substance or any expert at toxic substances would provide information on behaviour of these substances within the given environment. It seems useful therefore to collect informations about concrete pollutants and store them in a special block of questionnaires. The questionnaire block can serve to precise character of the pollutants.


GEORISK — KYJOV
POST-ACCIDENTAL AREA POLLUTION
A – heavily polluted area B – slightly polluted area
N
KYJOV
B
Brno, 1995 (C) Institute of Geonics & Masaryk University, Brno


GEORISK – KYJOV
BASIC GEOINFORMATION: TERRAIN
N
Brno, 1995
(C) Institute of Geonics & Masaryk University, Brno


GEORISK — KYJOV
POLLUTANT BEHAVIOR: IN GEOLOGICAL STRUCTURE
N
0
2 km
Brno, 1995 (C) Institute of Geonics & Masaryk University, Brno

7.3 Defining resolution level

Resolution level of the applied data issued from the use of a bottom map at the scale of 1:25 000 (Gauss-Krueger projection) with all used documents having been manually transferred into it after geometrical and optical corrections). Regarding that all these data should be presented on the screen of a common PC, a minimum area distinguished is 8 mm^2 (512 x 360 pixels).

7.4 Initial corrections and processing of basic documents

Proper preparation of the data for digitalization respected the need for harmonization. At transferring areals of valley bottoms, precise geometrical harmony was needed with preferring geological information which was considered to be most reliable. The same applied to border lines between soil types and soil species areas.

The methods and results of interpreting basic and integrated data have been accomodated into accompanying texts to each of the maps.

7.5 System structure and content

With regard to the fact that the data have to be permanently complemented and accommodated similarly as content of the proper geoinformation system, it was decided that presentation of the knowledge in traditional form of local atlas would not be made and all efforts were directed to generate a computer variant of the facility, hardware being the common personal computer 386. Instrumentation of this type is financially available to any organization which would feel a need for similar geoinformation facility and would not insist on any specific peripheries or accessories (colour screen and common printer are a condition). Software is designed for MS-DOS based computers and can be filed under current directories or stored together with data on floppy discs and installed when necessary on a disposable PC.

The post-accident information system GeoRisk in the version submitted has been designed as a local electronic atlas of the area of Kyjov under study. It means that it contains a whole range of fundamental and derived thematic maps related to the issue of environment impairment by a possible accident or to post-accident provisions. The maps represent a data base which has been complemented with a satellite photograph for orientation in the territory. The knowledge base is symbolized by the sequence of explanatory texts and purpose-oriented explanatory notes to the maps.

The present functional version of the GeoRisk system consists of the following three groups of stored data:

1. Entrance and explanatory text. The whole information system is being introduced with a text "GEORISK IS INTRODUCING ITSELF" which contains reasons for the system to be designed. The following text "TERRITORY IS INTRODUCING ITSELF" includes the basic description of the toxic accident and its scenery - location, size, basic elements of area character. In addition to these introductory texts, each of maps is being supplied with similar explanatory legends, be it basic maps or derived maps linking up with them. Up to now, the system contains three map series, each of three members, with accompanying texts which describe purpose-oriented geological environment, soil types and soil species, behaviour of pollutants in these environments, and explanation to selection of protection and remediation measures after the possible accident.
2. Basic and derived maps. These maps provide spatial information about the territorial differentiation and incidence of geological formations, soil types and soil species. The linking range of derived maps (purpose-oriented assessment maps) informs about behaviour of the pollutant at the soil surface (from the map of soil types), in the soil environment (from the map of soil species), and in geological bedrock (from the geological map - Fig.4). Another purpose-oriented series of maps provides a survey on distribution of protection and remediation measures in the area for the case that the territory has been contaminated.
   This group of information includes also elementary maps of traffic network, river network, relief (contour lines - Fig.3) and actual contamination of the area with toxic accident (Fig.2).
3. Legends to the stored maps. These are generally element legends in which all items contained in the given map are being accompanied by serial number and explanation to the contents of the sign.

7.6 System function and utilization

Major function of the GeoRisk system consists in providing to the user necessary information in the course of post-accident measures in the area.

The content of data files (text, map and legend) is presented in basic menu. In this basic menu the user can make his (her) own choice by using the code or the cursor. The selected file will then appear on the screen. Should this file be a map, the user can move the cursor across the screen and ask for an information about the given locality at a selected place. The information will appear in a special window in the corner of the screen. This procedure can be selected both at reading the map or for a combination "image-map" (a B/W map at the background of the image). Similarly, the user can magnify the selected place in order to learn the locality in details. The given file is easy to leave and the user can make another choice immediately.

The system does not enable the user to enter the data nor texts or legends. However, he is allowed to transfer selected data out of the system for his(her) own purpose-oriented processing. The user is welcomed to make combinations of a satellite imagery and contour maps of basic geoinformation, possibly also those of road maps or river network with any basic map or with satellite photograph.

Another method of use consists in looking for preliminarily determined combinations of parameters from individual basic maps.

8. Prospects of the GeoRisk system and other environmental GISs

The system of GeoRisk was built up in a version which can satisfy the common user with its user-friendly operation and suits anybody with no specific qualifications or skills. The user can get the data to his(her) requirements and does not need to use complex methods of computing technique. The given version is a basic model of the system, which can perform its function in the given area with no additional information with the exception of those describing the type and localization of the pollutant in the territory.

Establishing the computer assissted systems for geoinformational ensurance of hazardous sites should be obligatory for owners according to the law in the future. This kind of computer systems of geoinformation ensurance of hazardous localities will experience further modifications and improvements both in terms of its theoretical conception and as to its functions. This also applies to better utilization of remote sensing so that the imagery can be used to assess surface of the terrain from the viewpoint of categorization of active surface retention functions for the pollutant under motion, considerable reserves being seen also in possibilities of using digital model of the terrain. The three-dimensional simulations mean better instructive understanding of the accident area under study.

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GREGOR MENDEL AND URBAN ENVIRONMENT

Jan MUNZAR

Abstract

The article is a contribution to historical monitoring of environmental changes. It also brings some new information about deterioration of air in urban areas in the 60s of the 19th century on the example of Brno. The data have been excerpted from two meteorological publications by Gregor MENDEL, founder of genetics (1822-1884), of which the first deserves attention due to presented documentation on urban heat island including a discussion about its causes and introduction of a term "Rauchnebel" - German predecessor to the English term of smog. The second article presents interpretation of local differences in surface ozone concentrations detected by Schoenbein method both on the basis of differences in air pollution rate in the centre and in the outskirts of the town, and with regard to annual course of wind velocities (aeration).

Shrnutí

Gregor Mendel a životní prostředí měst

Článek je příspěvkem k historickému monitoringu environmentálních změn. Přináší některé nové informace o znehodnocování ovzduší měst v 60. letech 19. století na příkladu Brna. Jsou excerpovány ze dvou meteorologických publikací zakladatele genetiky Gregora Mendla (1822-1884). V první stojí za pozornost dokumentace městského ostrova tepla, diskuze o jeho příčinách a zavedení pojmu "Rauchnebel" - německého předchůdce anglického pojmu smog. Ve druhém článku jsou lokální rozdíly v koncentracích přízemního ozónu, zjištěné Schönbeinovou metodou, interpretovány jak na základě rozdílů ve znečištění ovzduší v centru a na okraji města, tak s přihlédnutím k ročnímu chodu rychlosti větru (provětrávání).

Key words: urban environment, air pollution, urban heat island, 19th century, Gregor MENDEL, Brno, Czech Republic