

Contemporary GIS-concept for Areal Management: GIS-platforms, modules, and technologies as providing tools for areal management

Topic 1 in INFORMATION TECHNOLOGIES IN AREAL MANAGEMENT for
master's degree in Human Geography

The lecture structure

1. The essence of Areal Management (AM). Contemporary geographic approach to managing the regional development – the methodology of GIS: **slides 3-15**
2. What is GIS in Areal Management? Key features of provision AM on the base of GIS-analysis: **slides 17-29**
3. GIS for thematic and regional projects in AM: **slides 31-44**

Basic literature sources

- *Костріков С.В., Сегіда К.Ю.* Теоретична і прикладна геоінформатика. Навчальний посібник для вишів– Харків: Вид-во ХНУ, 2016. – 592 с.
- *Костріков С.В.* Геоінформаційне моделювання природно-антропогенного довкілля. Наукова монографія. Харків: Вид-во ХНУ, 2013.
- *Світличний О.О., Плотницький С.В.* Основи геоінформатики: Навчальний посібник / За заг. ред. О.О. Світличного. — Суми: ВТД - Університетська книга, 2009.
- *Баранов Ю.Б., Берлянт А.М., Кошкареев А.В., Серапинас Б.Б., Филиппов Ю.А.* Толковый словарь по геоинформатике / Под ред. А.М. Берлянта и А.В. Кошкареева. – М.: Изд-во, 2007.
- *Берлянт А.М.* Виртуальные геоизображения. – М.: Научный мир, 2011.
- *Бусыгин Б.С., Гаркуша И.Н., Серединин Е.С., Гаевенко А.Ю.* Инструментарий геоинформационных систем: Справочное пособие. - К.: ИРГ «ВБ», 2005. - 172 с.
- *ДеМерс М.* Географические Информационные Системы. - М.: Изд-во Дата+, 2009.
- *Izard W.* An Introduction to Regional Science. London – NY: Prentice Hall, 1975. 506 p.
- *Maguire D.J., Batty M., Goodchild M.F.* GIS, Spatial Analysis and Modeling. – Redlands: ESRI Press, 2015. 482 p.
- *Ormsby T., Napoleon E., Groessl C.* Getting to Know ArcGIS Desktop. – Redlands: ESRI Press, 2011. 573 p.
- *Gorr W.L., Kurland K.S.* GIS-Tutorial. Workbook for ArcGIS. 2nd Edition – Redlands: ESRI Press, 2015. 353 p.

1. The essence of Areal Management (AM). Contemporary geographic approach to managing the regional development – the methodology of GIS

The essence of Areal Management (AM)

- **Areal Management is one of the key domains in the subject area overlapped by both Human Geography, Economy, and Management. In business, industry, and in governmental solutions, the information-based systems are increasingly becoming more prevalent. The trend is expected to grow in complexity in the era of segmented, "niche" marketing in the locational business, why the latter is strongly applied by Human Geography. As a functional information system, Geographic Information Systems (GIS) provide the methods, tools, and approaches to encompass the entire spectrum of areal / territorial management..**

The essence of AM (continued)

- **Regional management – areal management** is accomplished on various levels: the state governmental, regional, and the local governmental.
- Our discipline provides an insight into management information systems and the role of GIS in a locational business environment. The case studies presented in our workshops are intended to demonstrate the implementation of GIS within a management information system, to problem solving and decision making in marketing, resources management, and municipal/regional planning.

The essence of AM (continued)

- The definitions of «areal management» and «regional administrative management» are the synonyms in a broad sense. Nonetheless, it is necessary to take into account, that a region within a national economy can be considered as a separate economical entity, which possesses definite boundaries, governmental institutions, industrial and financial basics, and in a majority of cases this regional is outlined by the legal laws of the state. Usually, the definition of “a regional administrative management” is narrower, than “a regional management”.
- Before the regional management appeared, the intensive development of regional economy took place in fifties and sixties of the last century, when very famous American economist Walter Izard founded the U.S. Association of Regional Science (Philadelphia, 1954). He introduced the Regional Science Content: “In brief, Regional Science as a discipline concerns the careful and patient study of social problems with regional or spatial dimensions, employing diverse combinations of analytical and empirical research”. Among Soviet authors the first basic summarizing of economic problems of the region was provided by M. M. Некрасов in his book «Регіональна економіка», which concerned with the productive forces' allocation. It is reasonable to outline among Ukrainian scientists-economists the following publications: В. А. Поповкін, «Регіонально-цілісний підхід в економіці» - (1993); Чумаченко М. Г. «Очерки по экономике региона» - (1995; Топчієв О. Г. «Теоретичні основи регіональної політики» - (1997); Симоненко В. К. «Регіони України: проблеми розвитку» - (1997); Зайцева Л. М. «Регіональная система управления (организационно-методологический аспект)» - (1997).

GIS in the management of regional development

- From the general AM tasks, it is apparent that GIS represents a functional information system, having components that extend throughout the entire spectrum of a managerial information system, each segment of each is associated with a different management level, and incorporated into each of Transaction Processing System (TPS), Managerial Information System (MIS), Decision Support System (DSS), and Executive Information System (EIS).
- Geographic Information Systems (GIS) represent a class of functional information system designed mainly to manipulate geographic information organized as map layers and intended for Areal management solutions.

All Humankind's achievements prove that..



... Exactly applications of GIS provide a key performance in governing the Areal Management for Regional Development...

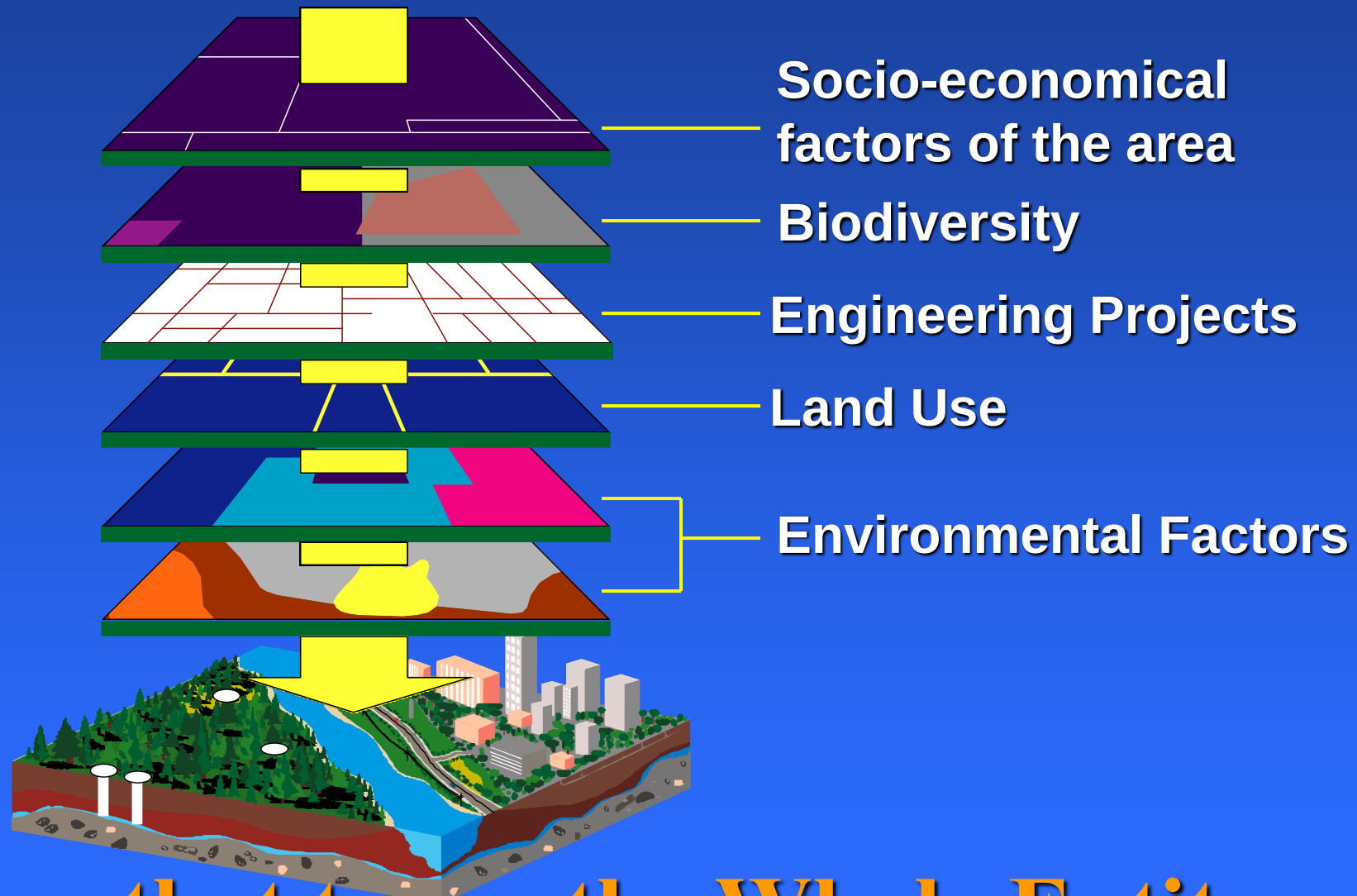
GIS is highly established for operating with data that are spatially or geographically oriented.



Exactly a Geographical Information System creates the basics for..

Slide 9

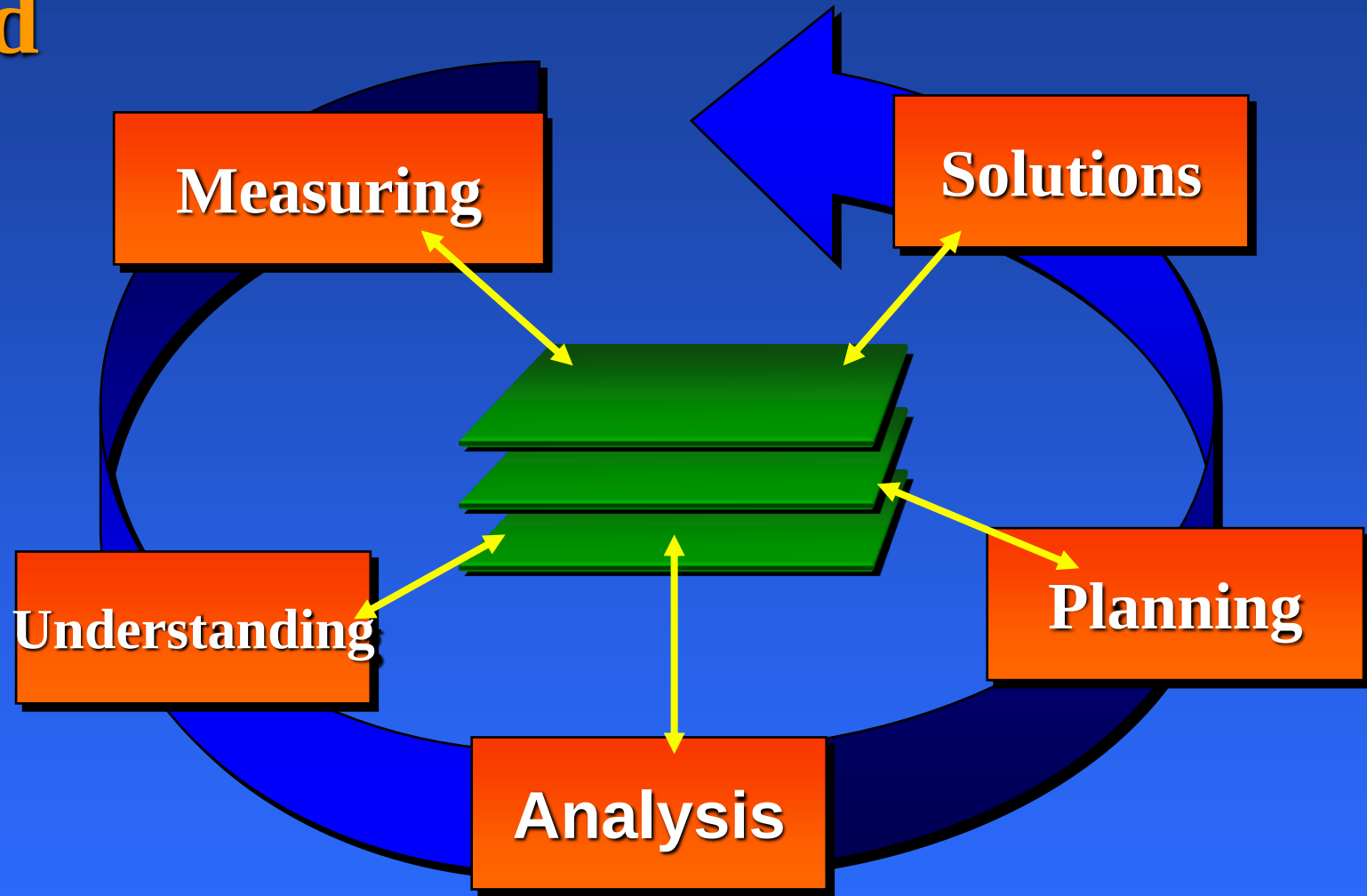
...measuring and integrating of Socium segments...



...so that to see the Whole Entity

Geoinformation System is that tool,
which provides **geographical
thinking** and ***spatial glance*** on
processes and phenomena within a
certain area – thus providing an
innovative geographical approach.
This **spatial glance** is:

- Interdisciplinary
- Integrated
- Global



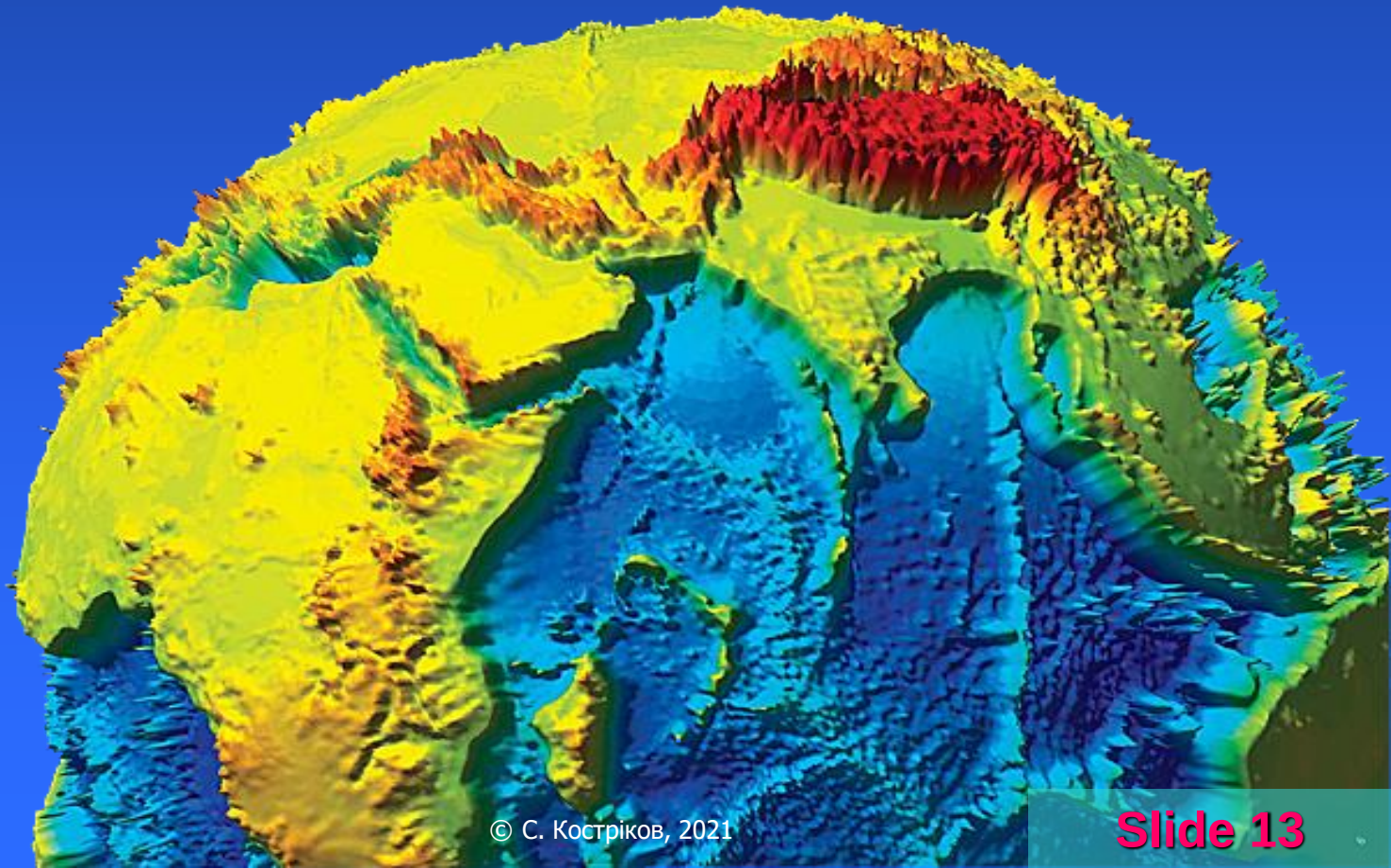
All these are general scientific attributes also eligible for
Geoinformation Concept in Areal Management

Geoinformation thematic domain – it is although an Innovative Science about our World, about territories of Our Being

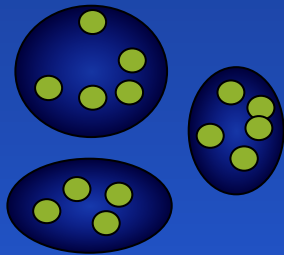
*Exactly an approach on the base of this concept
can be considered as the Basics for:*

- Understanding:
 - Essences
 - Relations
 - Processes
- Perception
- Presentation

...It integrates
our ideas...

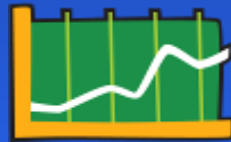
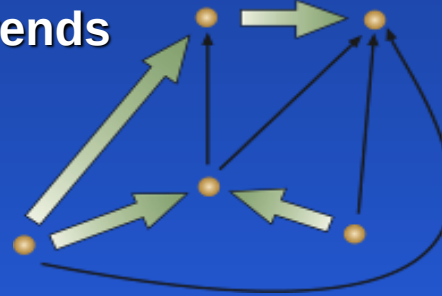


Theory and practice of GIS in AM combine Principles, Paradigms, and Methods



Models

Trends



Events



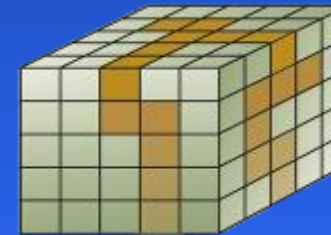
Distribution



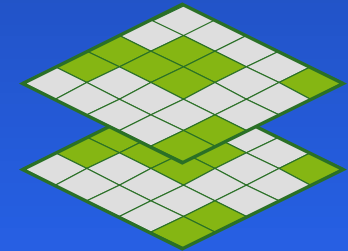
Differentiation



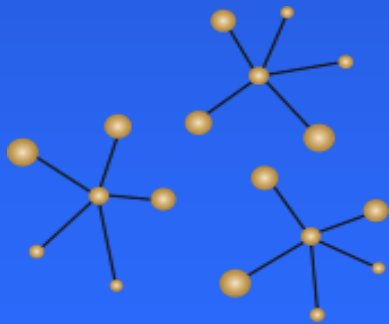
Classification



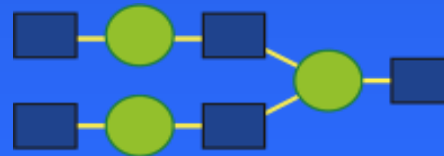
Circulation



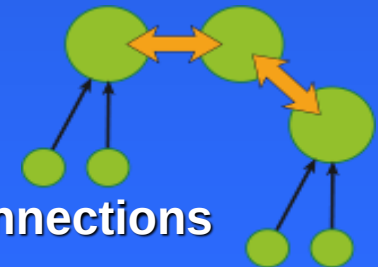
Spatial covariation



Interrelations



Processes



Connections

... All these thematic components expedite better understanding of the regional development

Questions due to the FIRST part of this lecture:

- What is the essence of geographical approach in Areal Management?
- What is the geoinformation concept in Areal Management?
- What is the Geoinformation Thematic Domain?
- List the general scientific attributes of the Geoinformation Concept in AM.
- What thematic components are combined by theory and practice of GIS?

2. What is a geographical information system in AM? Key features of GIS-provision on the base of GIS-analysis

Classic GIS-definition for Areal Management:

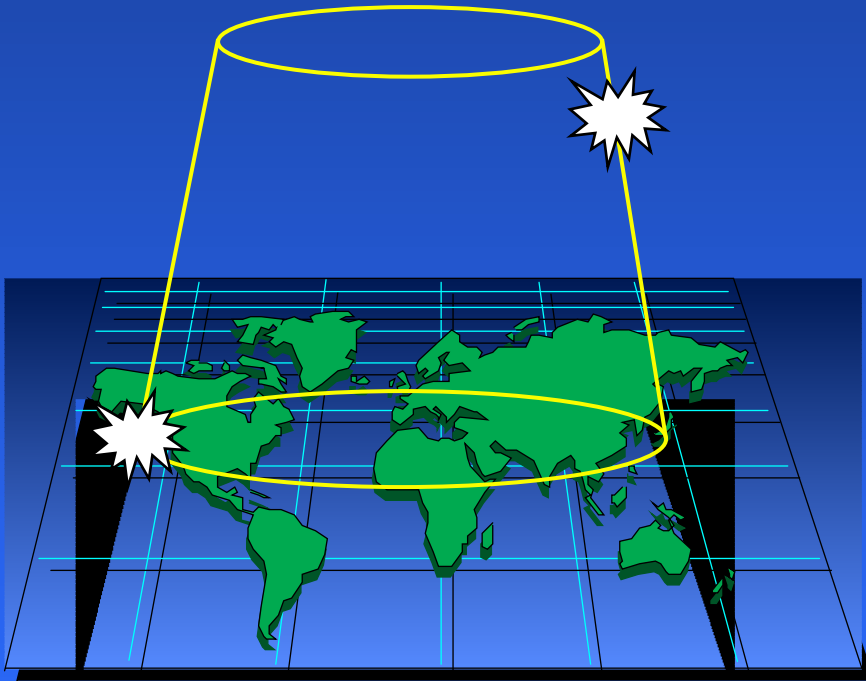
Since early nineties, GIS has evolved, in concert with development in computer technology, and today, GIS for AM may be defined as a system of hardware and software designed for data input, data storage and retrieval, data manipulation and analysis, and data output.

Thematic trends of GIS-applications in AM as a premise of GIS-analysis

- Generation of electronic maps
- Specialized GIS-modules
- Urban Building Cadaster
- Land Cadaster
- Cadaster of engineering networks
- Population cadaster
- Thematic Cartography
- Navigation
- Monitoring of Emergencies
- Internet

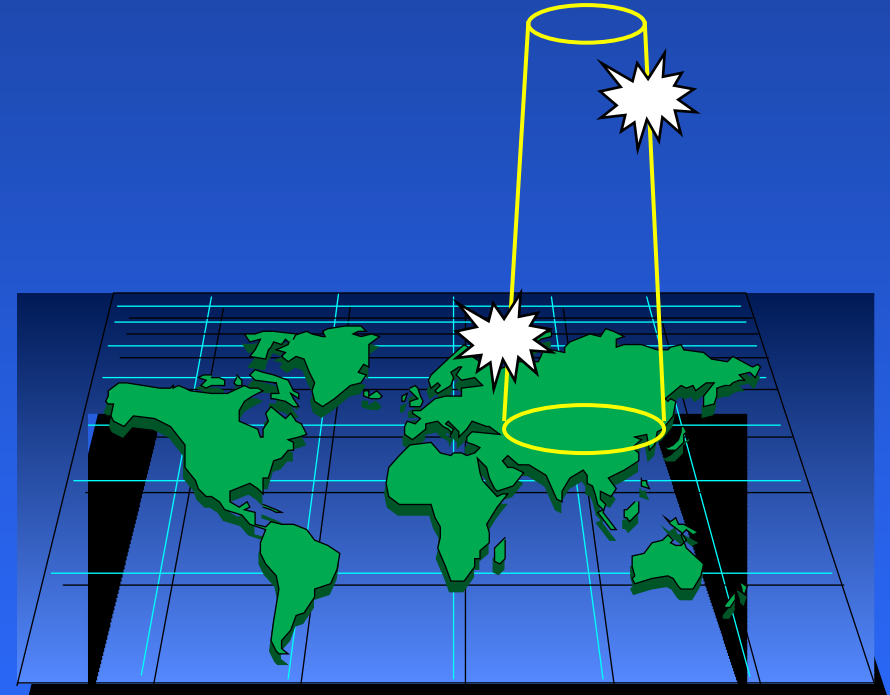
Essence and Content of GIS in AM

To see a Whole



- Samples
- Connections
- Trends

Governing of Locations



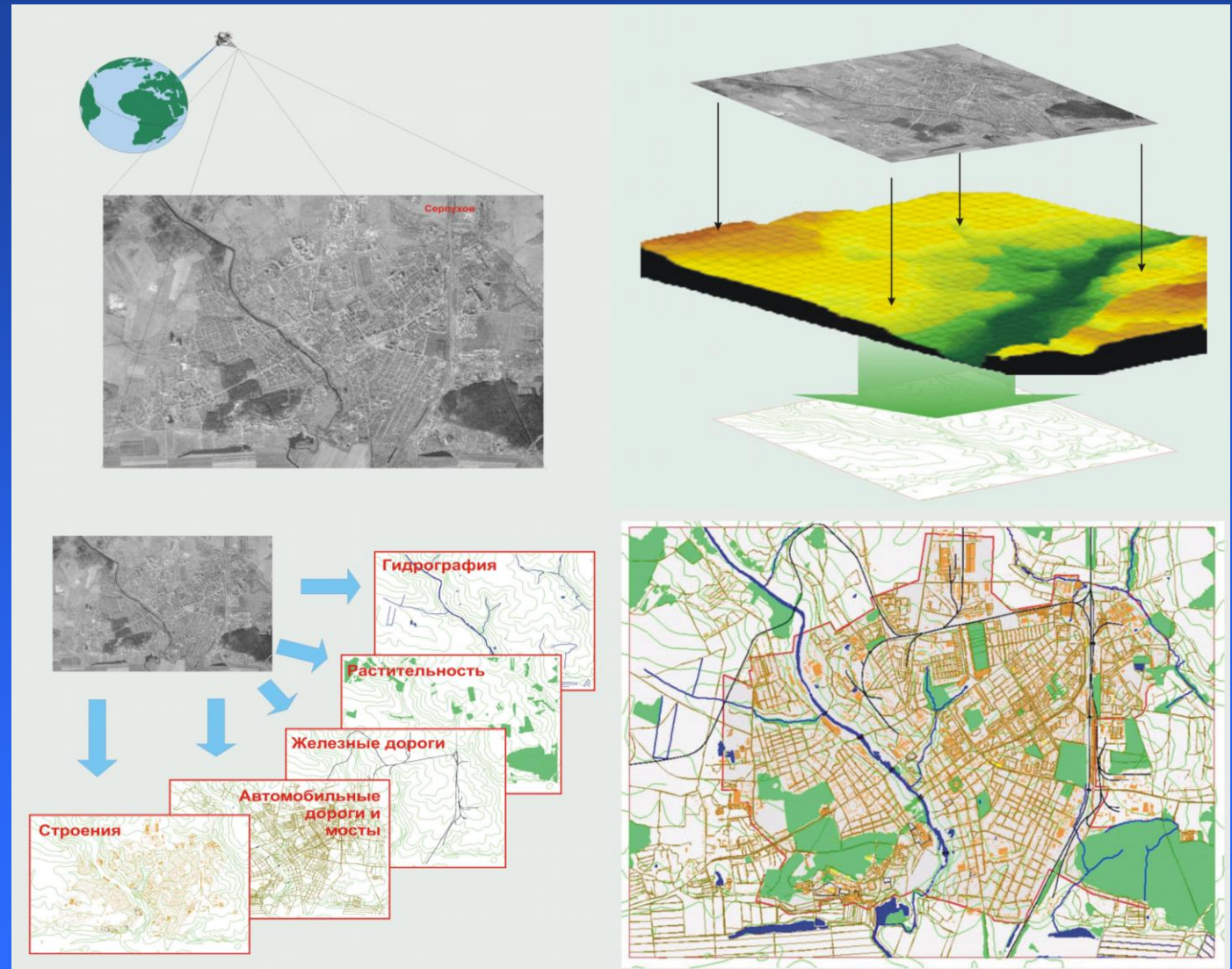
- Watersheds
- **Regional communities**
- Neighborhoods
- **Social-geographical systems**

ELECTRONIC CARTOGRAPHIC BASICS FOR A GIS

Photogrammetric
of Airborne remote sensing

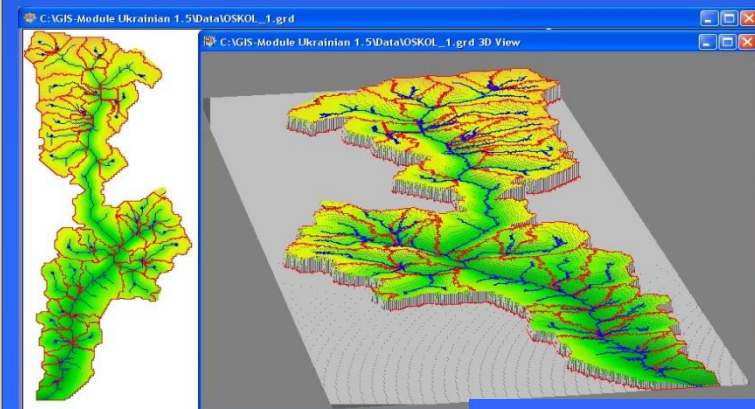
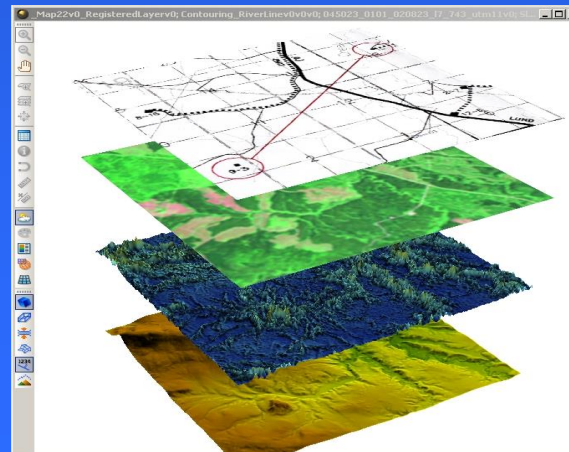
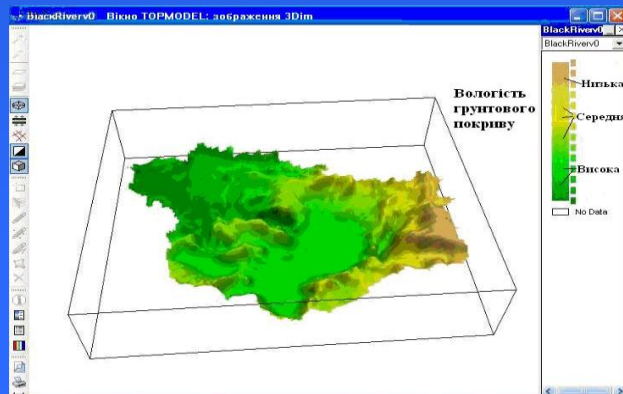
Formalized description of

Vectorization of
Cartographic
Load



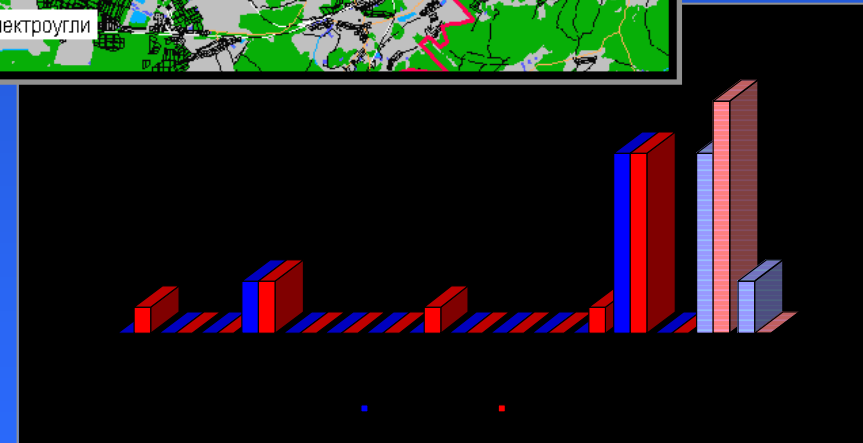
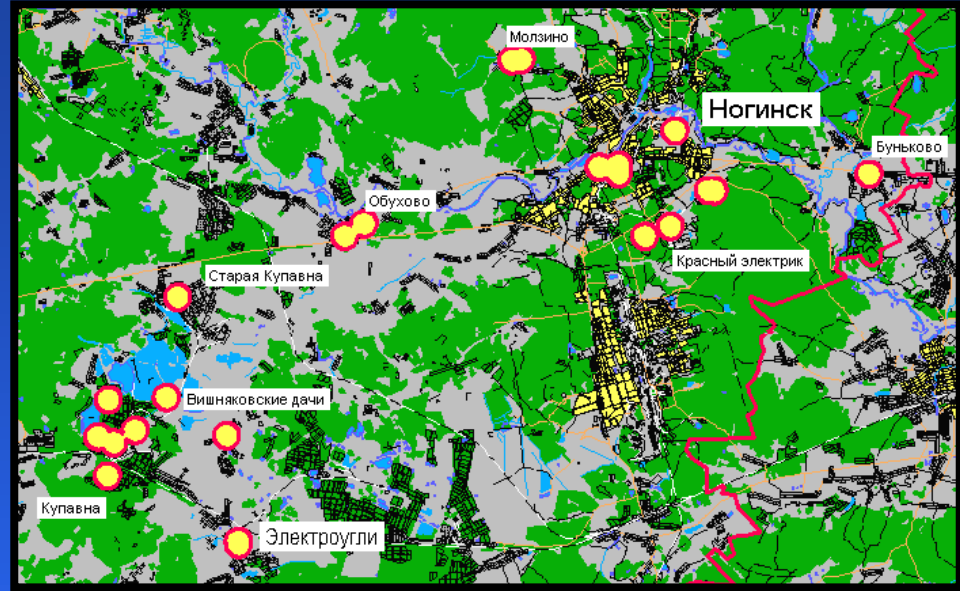
Geospatial data – data for GIS-Analysis in some subject domain of Areal Management

- These data contain the information, which identifies an allocation and characteristics of both natural, and artificial objects, as well as – their boundaries on the earth surface. This information can be obtained by remote sensing, mapping and with various survey techniques.
- *Geospatial data include* **four integrated components:**
- **Georeferencing**
- **Features and characteristics**
- **Spatial relations**
- **Time**

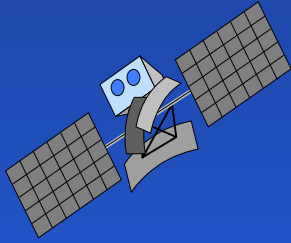


General Tasks of GIS-Analysis in AM

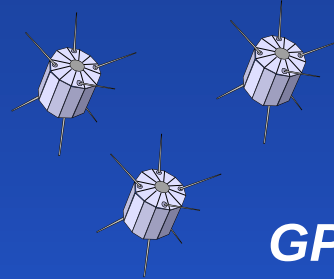
- Feature allocation analysis
- Numeric value distribution analysis
- Phenomena density mapping
- Seeking features inside an area
- Analysis of Neighborhood
- Change detection and mapping
- Determination of feature spatial attributes
- Feature categorizing
- Determination of distribution regularities
- Building a geodatabase
- **Resulting visualization**



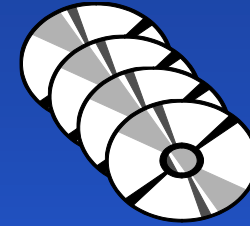
Primary data for GIS-analysis



*Satellite Images of high resolution
(1 meter) ERDAS*



GPS (Trimble)

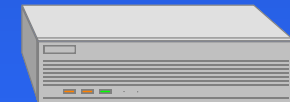


*Purchased GIS-
data*

Internet

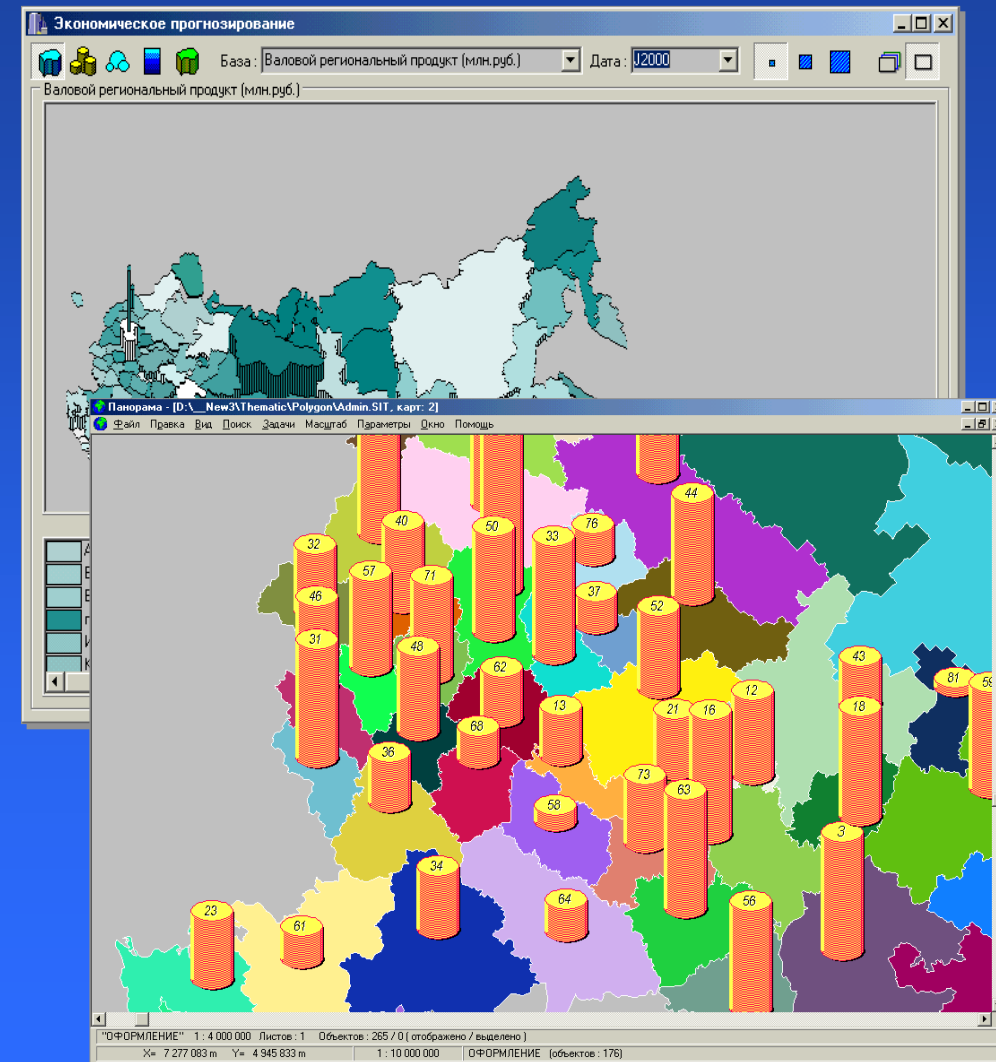
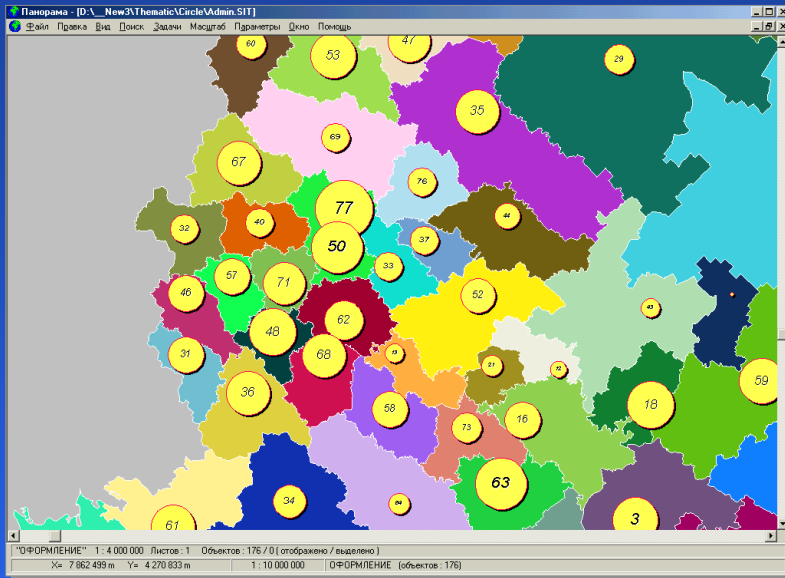


Data



*Scanning,
Digitizing*

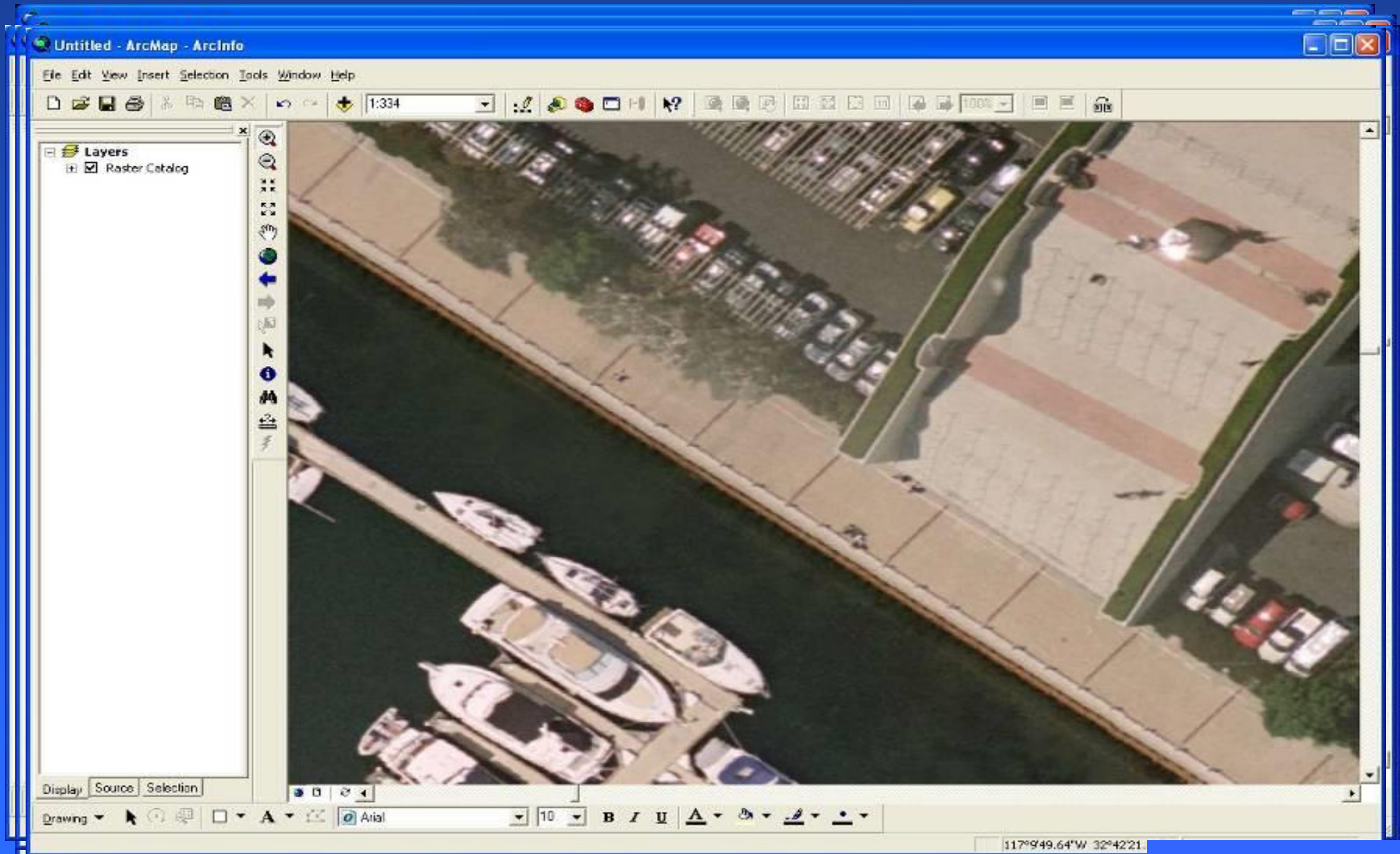
GIS as Management Information Systems for territorial planning in the regions



The use of information technologies, and their applications to management practices in regions is popularly referred to as management information systems (MIS). In general, within regional studies MIS may refer to an interdisciplinary field of study, influenced by other disciplines including computer science, political science, psychology, operations research, linguistics, sociology, and organization theory and behavior science. That field of study, which can be taken by GIS in this aspect may involve the use and manipulation of information to assist in effective decision-making at various levels of regional management in an organization of productive forces in this territory.

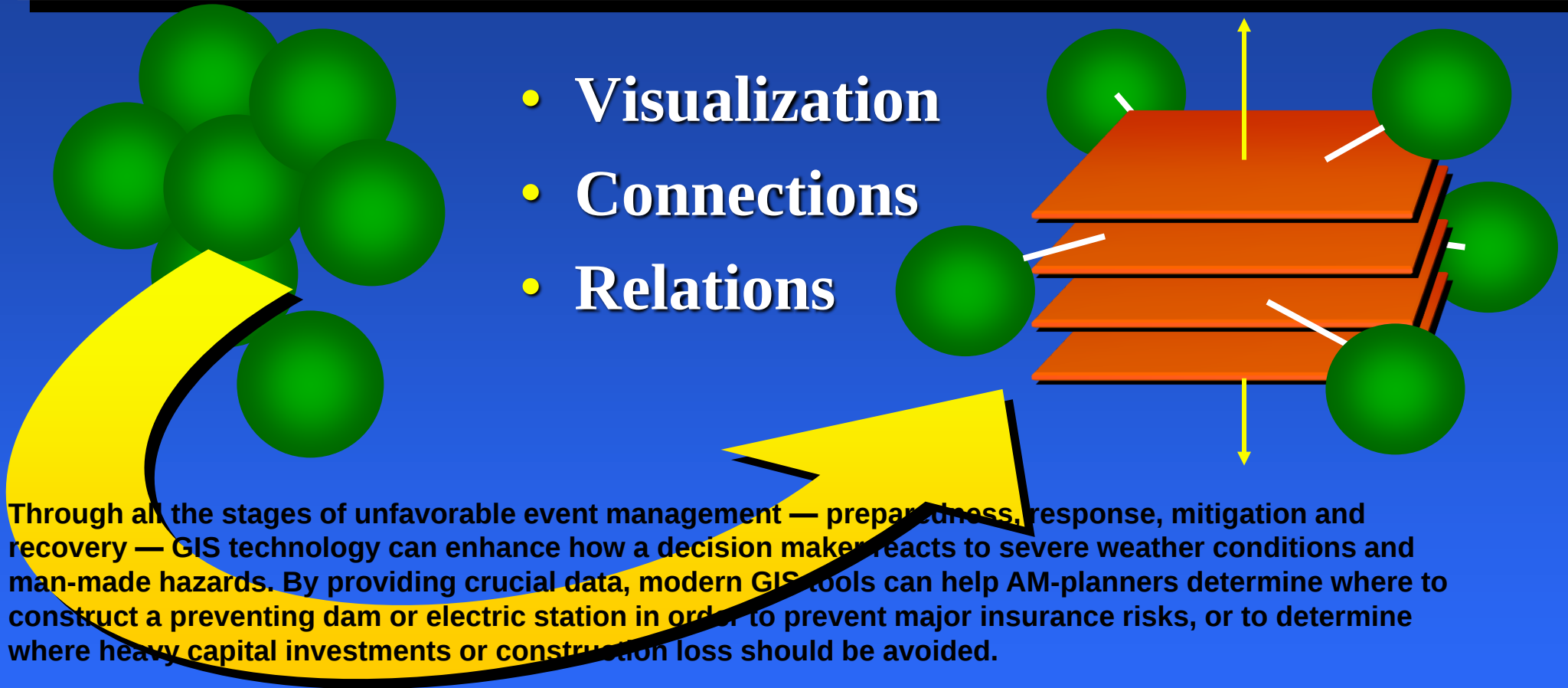
...also in a subject domain of areal
management **a GIS is a**
Language of
Vizualisation...

Usual interface of visualization in a GIS



A GIS combines information about key features of areal management

- Visualization
- Connections
- Relations

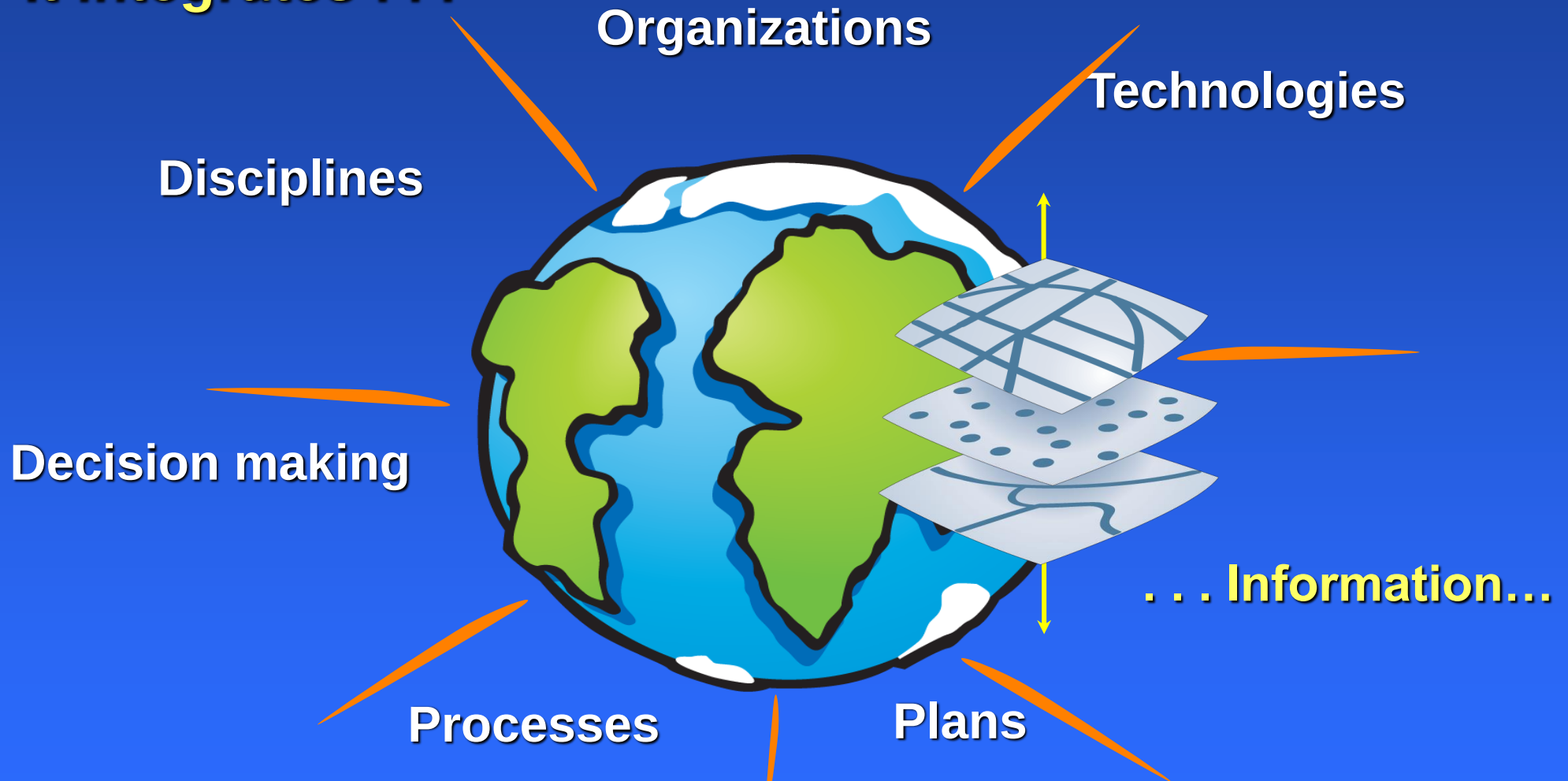


Through all the stages of unfavorable event management — preparedness, response, mitigation and recovery — GIS technology can enhance how a decision maker reacts to severe weather conditions and man-made hazards. By providing crucial data, modern GIS tools can help AM-planners determine where to construct a preventing dam or electric station in order to prevent major insurance risks, or to determine where heavy capital investments or construction loss should be avoided.

With specialized for AM GIS-tools you can easily visualize zones managed by some given laws and regulations, add critical locations, potentially vulnerable areas and even a layer with land parcel characteristics. This allows to accept wise managerial decisions within hours instead of months, making an information technology a must-have entity for public service initiatives, building developers, site planners, and sustainability-focused environmental programs.

Thus, a GIS is... ..an Areal Management's Language for any thematic domain...

It integrates . . .



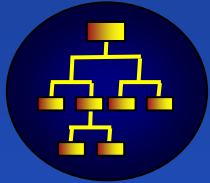
...and it expedites accumulating a GIS-expertise for AM

Questions due to the **SECOND** part of this lecture:

- Please, provide a classic GIS-definition for Areal Management;
- What is the essence and the content of GIS in Areal Management?
- What are the general tasks of GIS-analysis in a perspective of Areal Management?
- Describe a role of GIS as a Management Information System for Territorial Planning;
- Describe a role of GIS-visualization for AM;
- In what way a GIS combines information about key features of AM?
- What is a GIS as the AM's language?

3. GIS for thematic and regional projects in AM

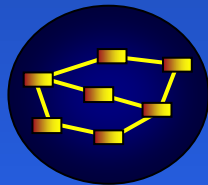
GIS describes the features and phenomena of AM by five elementary notions



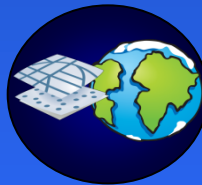
Data models



Data sets



Methods and models of processes



Geographical maps and globes



Metadata

**... All together these notions represent bricks of our
knowledge in AM**

The content of a Municipal GIS (M-GIS) — a sample of M-GIS from <https://gisinfo.ru/>

Владельцы (пользователи) компонентов МГИС:



A GIS for Urban Inventory, municipal and communal services

Відомості про житловий будинок

- Місцезнаходження будинку:
- Адміністративний район (Голосівський);
 - Вулиця (Горького);
 - Номер №165;
 - Власник (користувач) КП "ЖЕО-102"Голосівської м. Києві Раді
- Будинок належить:
- На правах: приватної власності, офіційного відеомого або приватного володіння, тимчасового користування, оренди, кооперативної колективної власності (потрібно підтвердити);
 - Строми;
 - Форма власності: державна, кооперативна, колективна, приватна (потрібно підтвердити);
- Метричні характеристики будинку:
- Кількість поверхів - 20;
 - Будівельний об'єм (куб.м.) - 12234.7;
 - Площа забудови (кв.м.) - 1450;
 - Загальна площа квартир (кв.м.) - 10717.17;
 - Загальна площа всіх видів приміщень (кв.м.) - 2541.3;
 - Будівельно-проектна площа приміщень, власні групи;
 - Загальний об'єм (куб.м.) - , загальна площа (кв.м.) - ;
- КІЛЬКІСТЬ КВАРТИР:
- Всього - 167;
 - 1-кімнатних - 3;
 - 2-кімнатних - 26;
 - 3-кімнатних - 108;
 - 4-кімнатних - 22;
 - 5-кімнатних та більше - ;
- КІЛЬКІСТЬ МІСЖАНЦІВ БУДИНКУ:
- Всього осіб - 611;
- ТЕХНІЧНИЙ СТАН БУДИНКУ:
- Рік побудови - 1990;
 - Рік останнього капітального ремонту - ;
 - Матеріал стін - цегла;
 - Ступінь зносу - 18.8%, дата інвентаризації - 01.11.2002 рік
- ПІДПИС:
- | | |
|-----------------------|----------------|
| Директор КП "ЖЕО-102" | Ткачук М.П. |
| Головний інженер | Адаменко М.А. |
| Головний бухгалтер | Володарка Н.В. |
| Економіст | Володарка О.В. |

Будівлі житлові (технічна характеристика)

Закладка1 Закладка2

Дата інвент.	Адміністративний район	Вулиця	Номер	Поверх	Квартир	Побудован	Ремонт
01.08.05	Голосівський	Саксаганського вул.	436	4	20	1917	1977
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01.08.05	Голосівський	Саксаганського вул.	37	4	16	1917	1989
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01.08.05	Голосівський	Жилинська вул.	34	4	16	1917	1988
01.08.05	Голосівський	Саксаганського вул.	31/27	4	11	1917	1953
01.08.05	Голосівський	Динирова вул.	22	3	15	1917	1961
01.08.05	Голосівський	Динирова вул.	22	3	15	1917	1961
01.11.2002	Голосівський	Горького вул.	170-172	5	64	1963	
01.11.2002	Голосівський	Горького вул.	169	5	61	1959	
01.11.2002	Голосівський	Горького вул.	166	12	62	1986	
01.11.2002	Голосівський	Горького вул.	165	20	167	1990	
01.11.2002	Голосівський	Горького вул.	164	14	113	1986	
01.11.2002	Голосівський	Горького вул.	162	11	74	1986	
01.11.2002	Голосівський	Горького вул.	157	7	39	1990	
01.11.2002	Голосівський	Горького вул.	155	5	52	1964	
01.11.2002	Голосівський	Горького вул.	154	11	67	1986	
01.11.2002	Голосівський	Горького вул.	152	11	68	1986	
01.11.2002	Голосівський	Горького вул.	152	11	68	1986	
01.11.2002	Голосівський	Горького вул.	150	14	49	1986	

Будівлі житлові (технічна характеристика)

Закладка1 Закладка2

1. Адміністративний район	Голосівський
2. Вулиця	Горького вул.
3. Номер	165
8. Кількість поверхів	20
4. Власник (користувач)	КП "ЖЕО-102"Голосівської м. Києві Раді
5. Право	
6. Термін	
7. Форма власності	
9. Будівельний об'єм куб(м)	12234.7
10. Площа забудови	1450
11. Загальна площа квартир	10717.17
12. Загальна площа всіх видів приміщень	2541.3
Кількість квартир	
14. Всього	167
15. 1-кім.	3
16. 2-кім.	26
17. 3-кім.	108
18. 4-кім.	22
19. 5-кім. та більше	
20. Кількість мешканців будинку	611
Технічний стан будинку	
21. Рік побудови	1990
22. Рік останнього капітального ремонту	
23. Матеріал стін	
24. Ступінь зносу, %, 18.8	
Дата інвентаризації	01.11.2002

Technical characteristics of buildings due to data from Housing Management Office

База данных для карты - D:\PLAN\Plan.map

Таблица Сервис Администратор Помощь

plan1.DB

Комната	Ответственный	Площадь	Дата_последнего_ремонта
301	Семенов Г.С.	10.7	07.07.97
302	Астахов В.Р.	14.7	02.07.96
303	Салатов С.В.	15.5	13.02.98
304	Арканов П.Т.	15.5	15.05.97
305	Селиванов А.А.	16.1	19.12.97
306	Васильков П.Г.	15.4	13.02.98
307	Иванищев К.К.	16.8	15.05.97

Всего : 34 Запись : 1

3 этаж 1 : 180 Листов : 1 (Крупномасштабный план) Объектов : 573 / 0 (отображено / выделено)

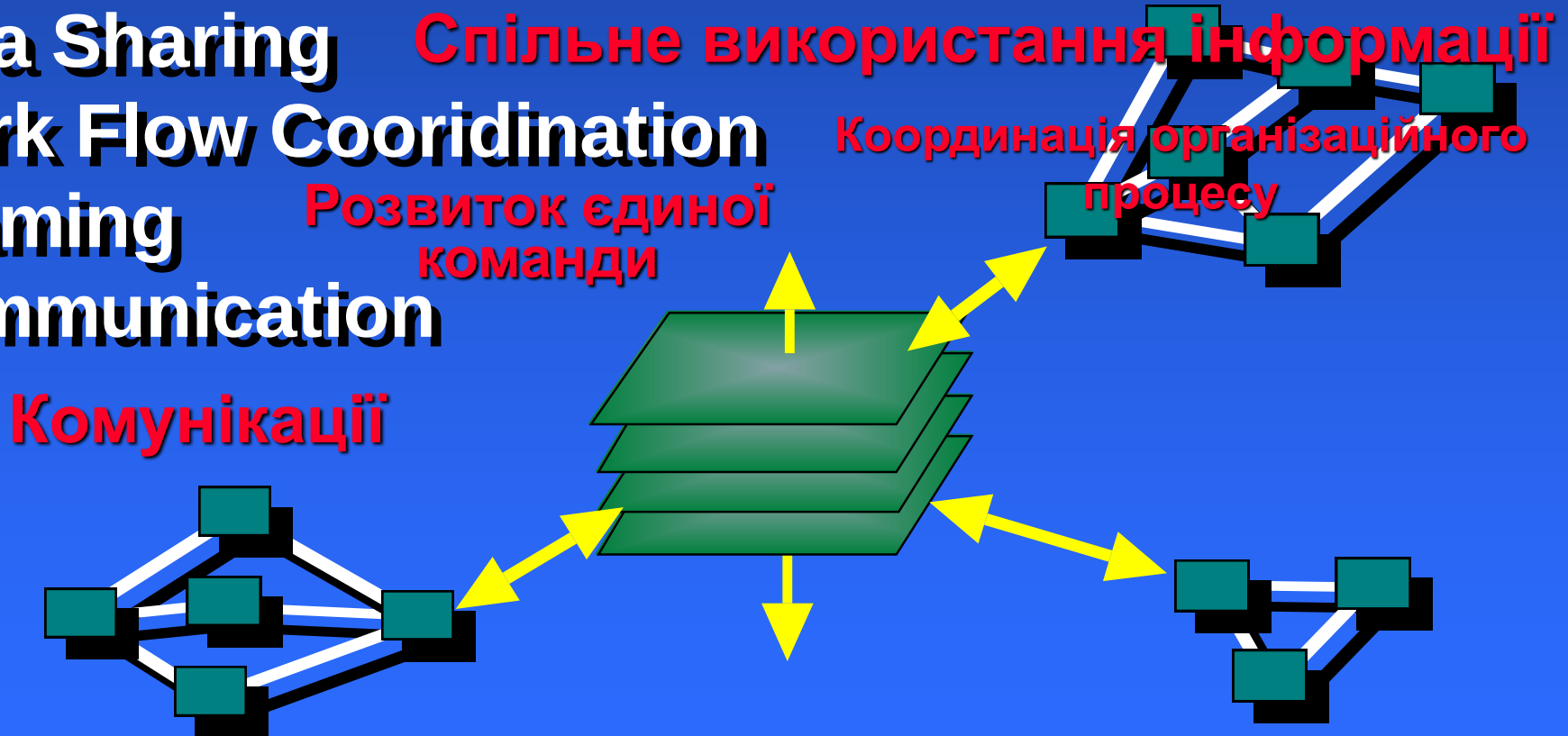
X= 6,46 m Y= 60,80 m 1 : 200 3 (объектов : 573)

**A GIS assists in better
arrangements of various
institutions and
organizations for, e.g.,
accomplishing the project in
areal management**

Organizational Consequences of Using GIS

Організаційні наслідки використання ГІС

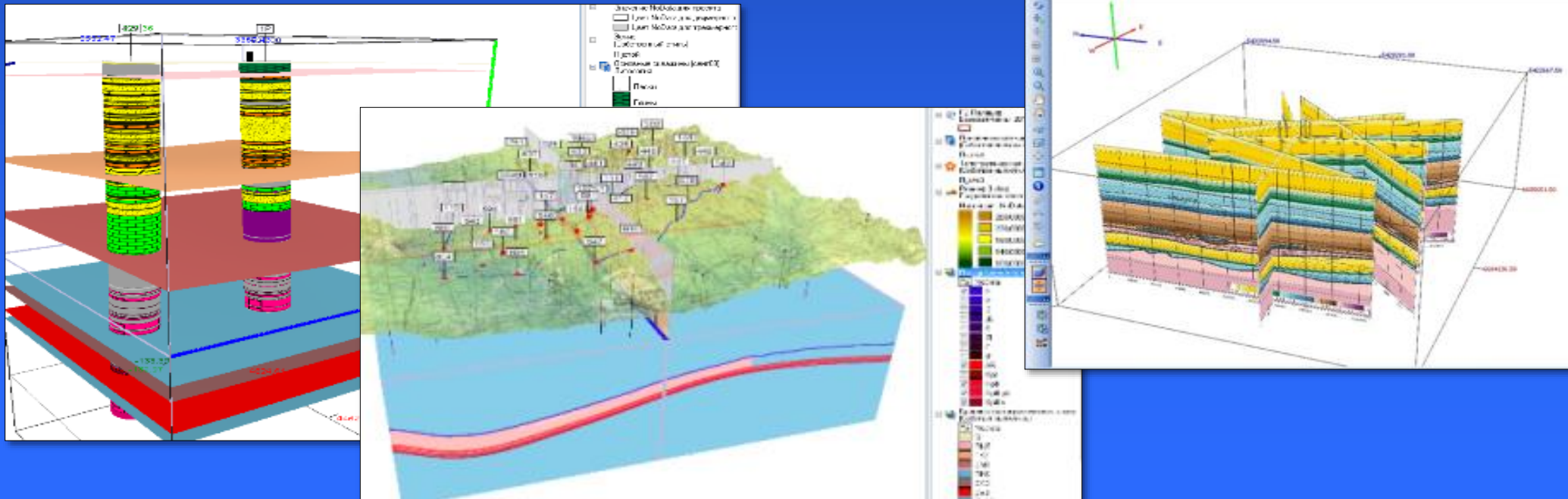
- Data Sharing **Спільне використання інформації**
- Work Flow Coordination **Координація організаційного процесу**
- Teaming **Розвиток єдиної команди**
- Communication **Комунікації**



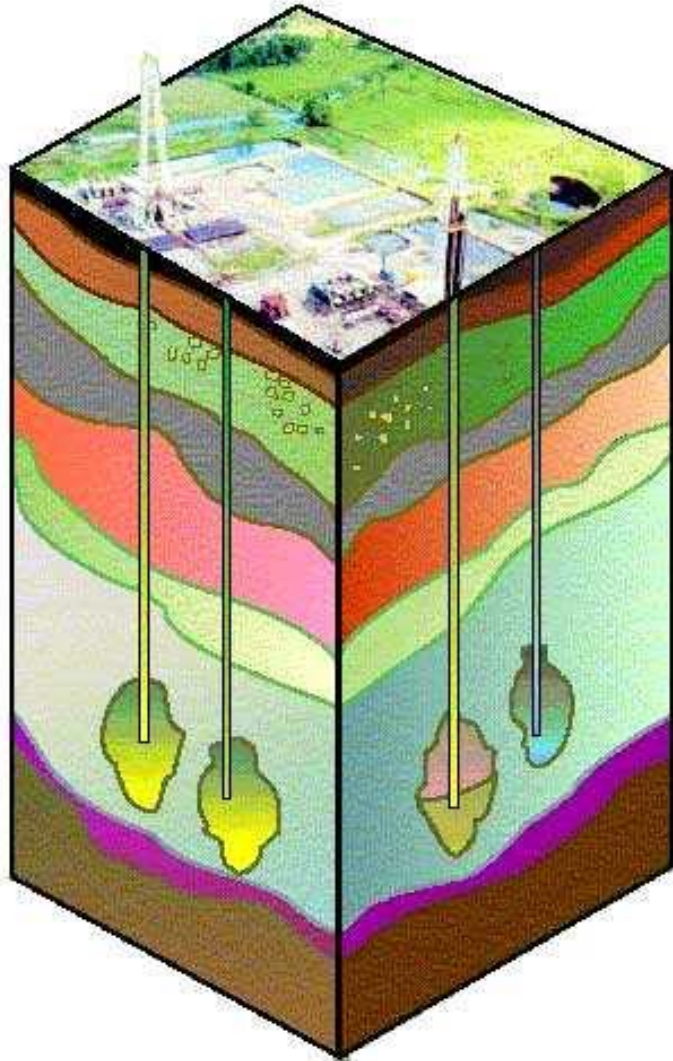
3D Geology modeling for AM of mineral deposits

Three2N, Inc., specialized software Company suggests AM-solutions in mineral deposits processing:

- The software system allows to create, edit and review drillhole information and to assess the exploration results in the interactive mode;
- Interactive planning of vertical, horizontal or directional drilling taking into account the deposit geological structure, the deposit genesis and all nuances of specific technology and available drilling equipment;
- Additional optimization allows to find the most efficient plans resulting in potential and operational cost reductions;



A mineral deposit of hydrocarbon – Spatial Data integration



Integrating data from many data sources

Integrates Data:

- From existing internal systems – such as Autodesk, ArcGIS, MapInfo, Gocad
- From existing external and public sources – such as GeoBase, CLI
- From different government departments – Federal, Provincial, Municipal
- Quality Assurance detects differences between data sets

Integrates many different types of spatial data such as:

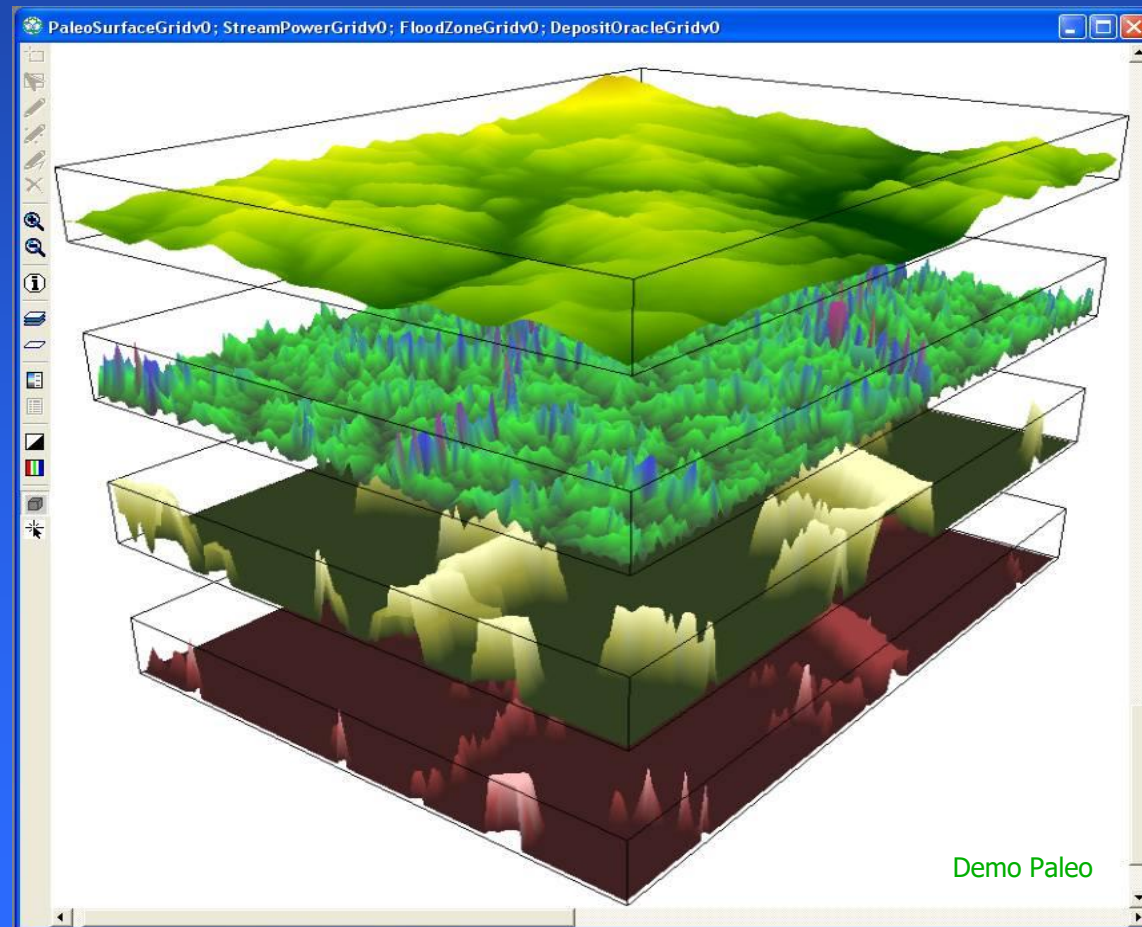
- Digital Elevation Models
- Scanned images and maps
- Vector map data – roads, rivers, contours
- Raster map Data – aerial photographs, satellite images
- 3D objects – buildings, geobodies
- Geological data – drillhole and log data, geological models
- Engineering data – surface and subsurface

The deposit scheme – illustration



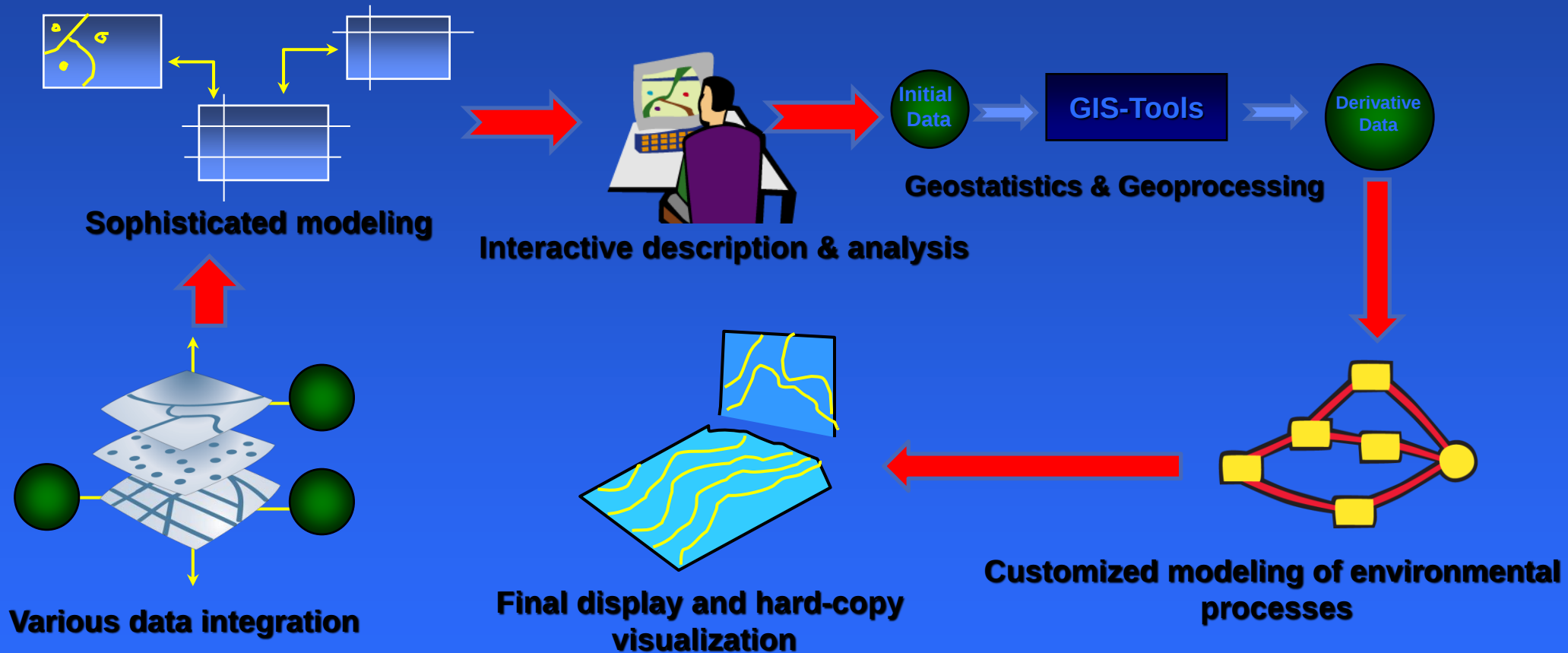
Software for grounding a shaft development of mineral deposits

- Solutions for engineering geology, mining, and ecological security for shaft development;
- Solutions for subject domains in Areal Management, which demonstrates a definite spatial aspect;
- Unique technology of directional drilling and hazardous waste allocation optimizing



Routine Operational GIS-workflow: for Areal Management

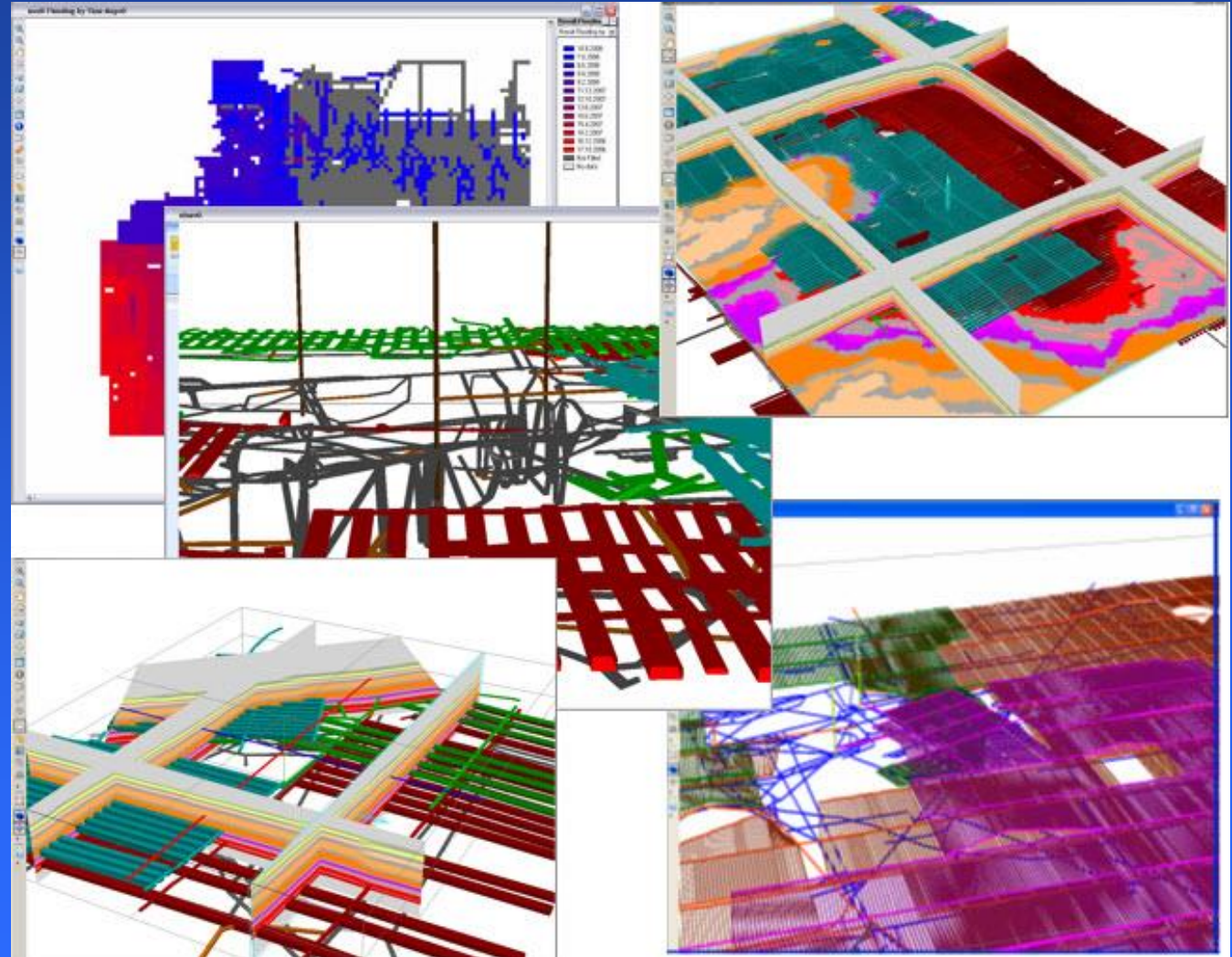
Introducing GIS-concepts and methods for the descriptions with LiDAR data



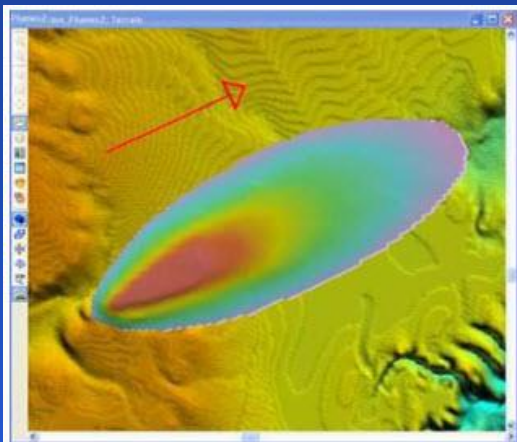
Samples of GIS-solutions concerning the urban underground infrastructure

3D City Underground Tunnel Topology:

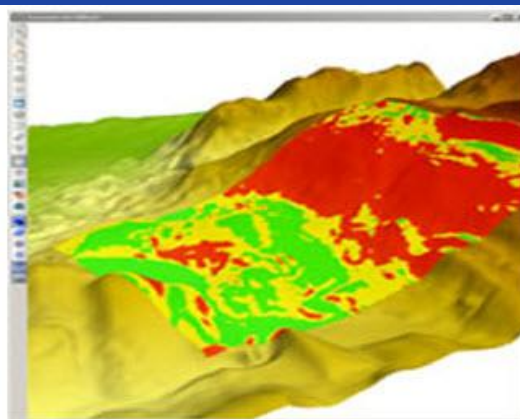
- Build models of u/g city infrastructure;
- Topologically connect tunnels in 3D Scene;
- Intersect **of u/g city infrastructural** workings with local geology, hydrogeology, topography, etc.;
- Infrastructural Planning;
- Emergency Response Planning.



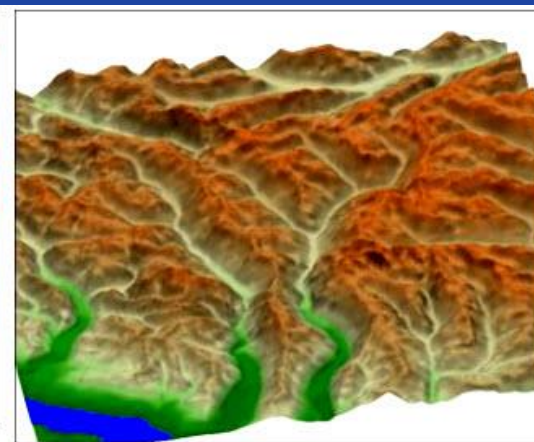
Samples of GIS-solutions in different domains of Areal Management



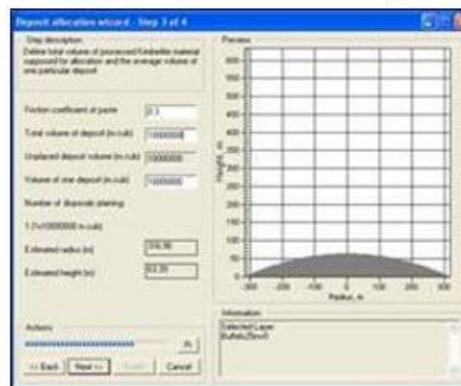
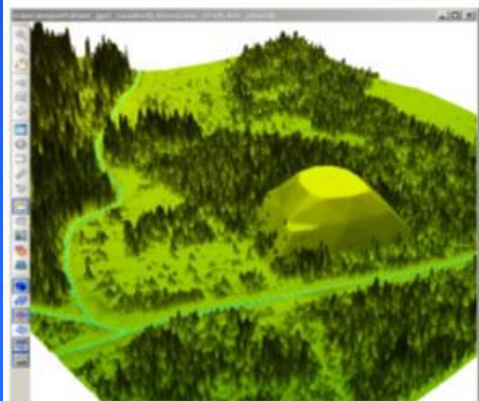
Wind erosion and pollution distribution modelling



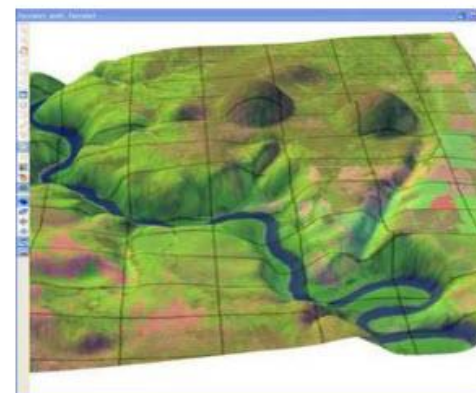
Terrain classification for industrial waste disposal



Watershed management



Tailings disposal modelling



Questions due to the THIRD part of this lecture:

- ***In what way GIS describes the features and phenomena of AM?***
- ***What is the content of municipal GIS?***
- ***Please describe a routine GIS-workflow for Areal management;***
- ***What is the spatial data integration in modeling mineral deposits of hydrocarbons?***
- ***What are the organizational consequences in Team Building?***
- ***Please list the software samples for modeling the geological environment;***

**Thank You for Your
Interest in Areal
Management 😊😊😊**