PROBLEMS OF CREATION OF GIS-SUPPORT FOR THE AMUR RIVER BASIN PROJECT

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Necessity of development of special information and, first of all, geo-information provision for realization of large nature conservation and nature management projects is rather obvious now. The geo-information provision is a basis for environmental and geographical studies that use diverse data on natural, and social and economic phenomena. The most substantial results of such studies, in our opinion, should be represented as the relevant geo-information block.

The main purposes of creating GIS to research opportunities for sustainable nature management and development at the regional level, and in particular, in the territory of large river basin like the Amur River basin are as follows:

1. Systematization of available information about the region, its completeness, detail urgency, in other words, estimation of a level of geographical knowledge of the region.
2. Ordering the diverse spatial information about the basin's territory.
3. Pictorial representation of the primary and newly received data by way of electronic and printed maps.
4. Creation of geo-information base for:
   - Solving problems on estimation of spatial ratios, interrelations of separate components of natural systems, settlement systems, economies;
   - Development of regional programs of sustainable nature management and sustainable development;
   - Organization of environmental monitoring.

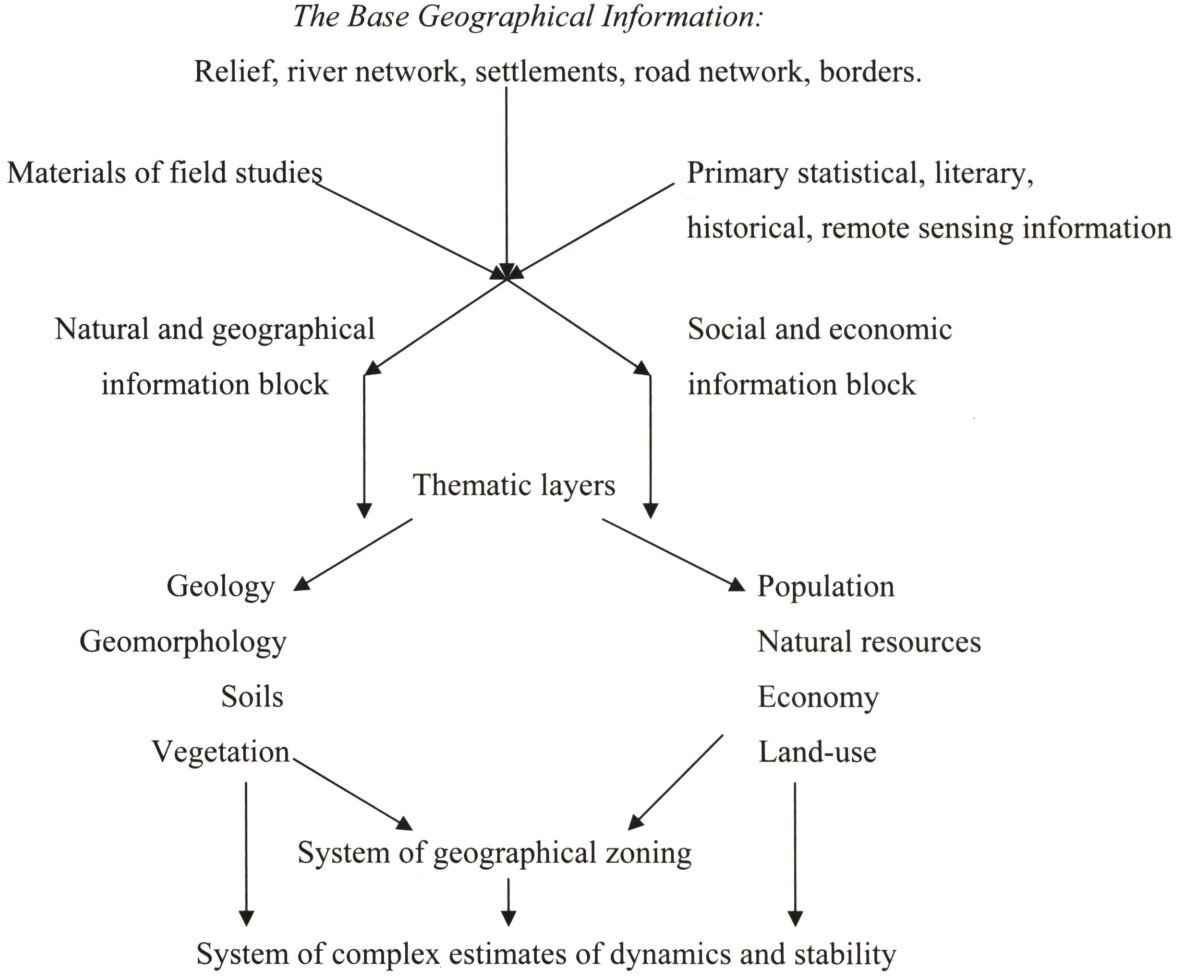
Having been conducted in Pacific Institute of Geography, Far Eastern Branch of the Russian Academy of Sciences, the studies show great opportunities for use of GIS-technologies in solving various environmental and geographical problems and creation of regional and object-oriented GIS (Ermoshin V.V.,Murzin A.A., 1999; Krasnopeev S.M. Ermoshin V.V., 2001; Ermoshin V.V., 2002; Baklanov P.Ya et al, 2004; Sustainable development …, 2004; Offers on creation …, 2004).

With use of an algorithmic combination - spatial superposition and ratios of separate geo-information layers there exist a principal opportunity to form any composite cartographical product with specific purposes and to solve a row of spatial geo-system problems:

1. Geographical partitioning territory (zoning, dividing into districts) aimed at allocation of homogeneous areas, complete geo-systems and their various types;
2. Allocation of areas, zones with the certain set characteristics of separate components;

3. Allocation of the territorially expressed anthropogenic factors impacting the environment;
4. Estimation of correlation ties between spatial areas of natural components, population, economies;
5. Estimation of geo-systems stability, including its various types and ranks;
6. Predictive estimates of geo-systems' dynamics, including those under the influence of anthropogenic factors.

In the framework of the project regarding to our studies the following macrostructure of GIS various completeness is planned:



For every thematic layer its own classification of displayed parameters should be developed and agreed, but they together should form a perfect whole, spatially coordinated system. It is expedient to define some structural levels of estimates or scales of mapping. The most optimal scales are: 1:2,500,000 and 1:500,000. The first one is intended for collection and mapping of the data on around the whole Amur River basin, and the second one is used

for more detailed works on separate key areas. In this respect, it is supposed, for example, that in the land-use layer the following types of use will be reflected:

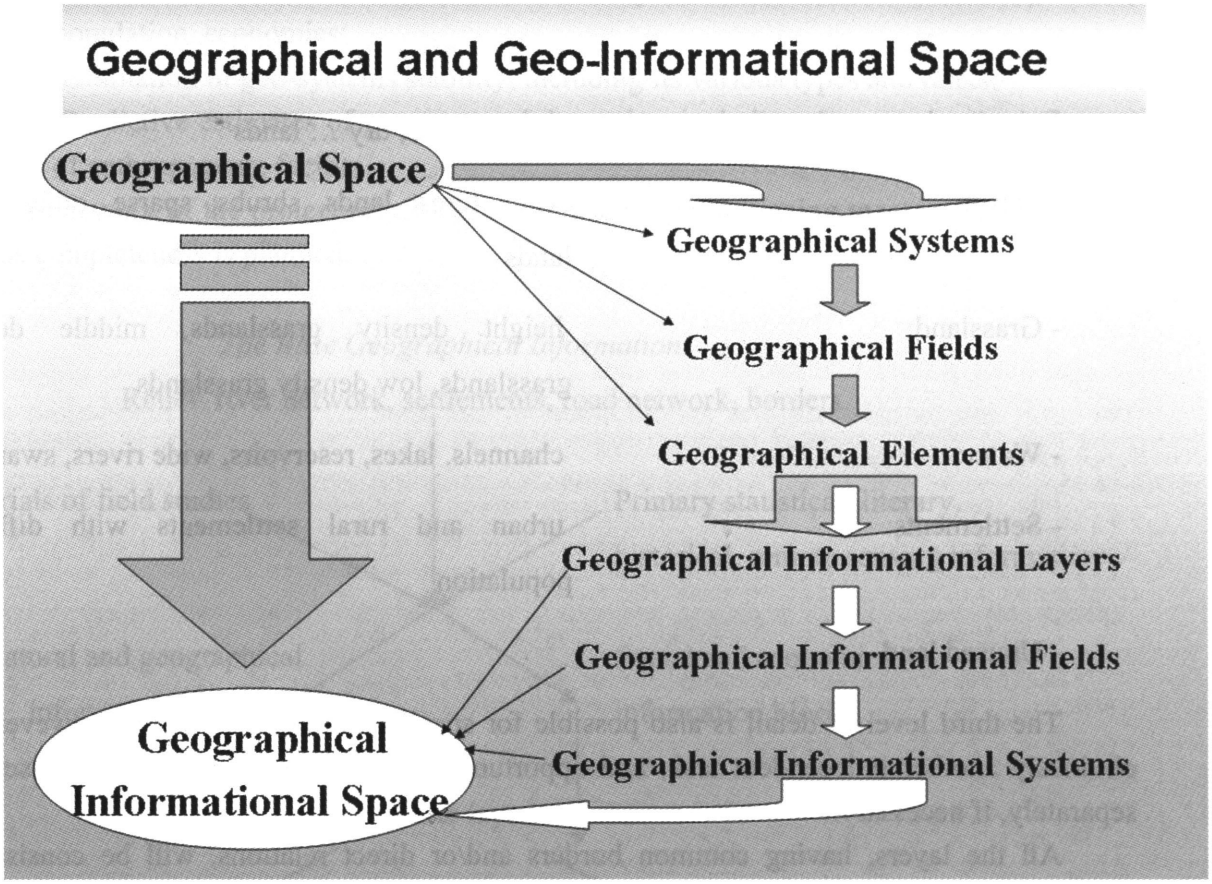
Scale 1:2,500,000	Scale 1:500,000
- Arable:	paddy fields, dry … lands
- Forest:	dense forest lands, shrubs, sparse, other forest lands
- Grassland:	height density grasslands, middle density grasslands, low density grasslands
- Water:	channels, lakes, reservoirs, wide rivers, swamps
- Settlements:	urban and rural settlements with different population
- Unused land	

The third level of detail is also possible for specific problem territories, however it is obviously another independent task, and opportunities for its solution should be discussed separately, if necessary.

All the layers, having common borders and/or direct relations, will be consistently coordinated among themselves like at complex and atlas mapping to form original logic spatial series. Practically every series has at least one crossing with others. Thus, directly or indirectly the vast majority of layers has common invariants. The following examples of the most obvious substantial coordination of electronic cartographical layers as series can be namely: river network - relief - road system - settlements - land users; river network - administrative and frontier borders - protected territories - recreational resources, etc. Information layers are formed in a vector format of ArcViewGIS/ArcInfo platforms.

Geo-information provision for regional projects should be considered as not only auxiliary, but also as having an ultimate goal to form a uniform geo-information space of specific territory. Geo-information space is understood here as multi-level, poly-layer, territorially and inter-componently structured information model of geographic space. Therefore, it is desirable that base geographical electronic layers should be generated mainly prior to the beginning of full-scale summary works under the project and should be used by all the concerned participants of the project. Further, the satellite data and other available thematic information (transferred into electronic layers) including newly received one will be attached to these layers. Thus, it will provide an opportunity for strict spatial analysis and comparison of the data, including historical and dynamic aspects. All the participants of the project, not only those directly engaged in GIS creation, but also those associated with reception and processing of the spatial information are encouraged to adhere to this approach.

Only this approach makes possible a principle of adequacy of geographic and geo-information space that is modeled on the scheme.



Proceeding from the accepted purposes, the following work phases to form a geo-information provision for the Amur River Project are defined as:

1 phase Compilation of electronic layers for the whole basin territory of the scale 1:2,500,000. It includes:
- Creation of common geographic base electronic layers like relief, river network, settlements, road system, borders in a uniform standard and scale;
- Agreement on used geographic names and borders, the general and specific editing;
- Creation of relief 3D-model;
- Creation of electronic thematic layer of land use represented on the basis of satellite images analysis;
- Creation of electronic thematic layer of geological structure.

2 phase. Compilation of electronic layers for the whole basin territory of the scale 1:2,500,000. It includes:
- Creation of electronic thematic layer about land use in 1960 according to literary and archival sources;
- Creation of electronic thematic layer about land use in 1900 according to literary and archival sources;

- Creation of database and electronic layers about population and economy.
- Creation of electronic thematic layer about soils.

3 phase. Creation of electronic layers as above about the specific territories at a 1:500,000 scale
- Zeisko-Bureinskaya Plain
- Middle Amur
- Lower Amur

Each of these three phases includes seeking for and collection of data, digitizing and editing electronic layers and databases, input of data into the bases, compilation of Arc/INFO layer, unification of data according to the common standard and scale, adjustment of names and borders, etc.

4 phase. Final edition of all the layers, their unification according to common standard, spatially combined analysis of available information about objects and territories, specific zoning according to the action of key factors, including anthropogenic ones.

At the same time it is necessary to take into account that all these data on the Chinese and Russian sides of the basin will be received from various sources, and then should be processed, corrected and interrelated. Therefore, prior to the beginning of the works it is preliminary necessary to stipulate with partners from other countries all possible technical parameters of collection of the information namely: scales, projection, detailed, classifications, language, etc to avoid possible problems. Nevertheless, the specific feature of the projects fulfilled on trans-boundary territories, consists in discrepancy between the initial data on the territories in various countries (Ganzey S.S., 2004; Ermoshin V.V., 2004). Accordingly, there is a set of problems of geo-information exchange, interplay and formation of uniform geo-information space like:

1. To a variable extent, almost all the layers, both common geographic, and thematic ones, could not be joined with each other along the state boundaries.
2. Toponymic geographic names, in national language and in English are essentially varied in neighboring countries; therefore a selection of the uniform principle of cartographical representation and adjustment of the names is required.
3. There are also distinctions in the notions of the same objects, e.g., nature reserves, types of land-use, etc.
4. Various estimates of the anthropogenic factors, ecological standards and restrictions.
5. Various approaches to classification of complex objects (roads, settlements, types of vegetation, types of land-use). Since different substantial notions, principles, fundamentals can be used in classifications, and gradation numbers do not coincide now, definition of the common basis is necessary (Ermoshin V.V., 2004).

All the listed problems are solved consistently, first of all conceptually, then technically and practically. Conceptually means defining and agreement about the common fundamentals for classifications, for example, motor roads can be generalized to the primary and secondary

ones only. Technologically means determining the sequence of overlapping (binding) layers and the principles of their joining along the state boundaries on the basis of invariant geographic structures and lines of geographical space like watercourses, roads, etc. Practically means that all the uniform layers are joined and compiled, the topology of objects is built up, and the layers are joined with each other forming horizontal and vertical structure of information space.

At present, the initial inventory of available geographic information about the territory of the Amur River basin, its types and kinds has been carried out. We have Landsat 7 imagery for the key areas of the Russian part of the Amur River basin, where the studies at a 1:500,000 scale are planned. Landsat 7 and Landsat 5 imagery is also available for the certain area of the basin, mainly its eastern part. It is anticipated to purchase MODIS imagery of the whole basin territory as the more adequate information basis for small-scale constructs and analysis. Available common geographic digital maps consisting of layers of road and transport network, administrative and state borders, settlements, hydrographic network require serious revision, standardization and joining along the state boundaries. The sources for compilation of thematic electronic layers, like geological, soil, economic, vegetation, land-use, especially in historical background, are rather incomplete, and are often contradictory. Their digital versions are practically absent, and printed versions are of the various scales, having different classifications (map legend), and in some cases they do not cover the whole basin area. Regarding to it, coordination of the geographical information for thematic layers about different sides across the state boundaries is more difficult and problematic.

The present project envisages realization of only partial functionalities of GIS. That is, firstly, an inventory and translation of common geographic information like relief, hydro-network, borders, settlements location, roads system, and of basic thematic information like geological structure, soils, vegetation, economy into the digital form. Secondly, a reception of new systematized data on modern land-use on the basis of the analysis of satellite information and field researches is planned. Thirdly, visualization of the listed layers as summary electronic maps is foreseen.

In our opinion, it would be expedient to use these base layers for coordination, interplay and analysis of all information about the Amur River basin, received in the course of the project. In particular, it concerns the materials about anthropogenic pollution, analysis of the role of geomorphic structures in river drainage, etc. which are supposed to get from other research blocks made by other groups. In other words, it is rather useful to realize such an important feature of GIS as its openness for operative information updating.

Thus, it creates the preconditions to forecast and plan certain nature protection actions in the territory of the Amur River basin, adjacent territories and water areas, and also to carry out special kinds of zoning, including functional one, which determines priorities and restrictions in regional nature management. It is desirable to provide an opportunity for aggregation of all the spatial data received in the course of the project in a uniform geo-information system on the basis of its standard base layers. It will allow us to conduct a relatively full-scale (overlay) analysis of the various data in a uniform key at the final phase,

to make more adequate estimate of the status, and to plan further actions and activities on improvement of nature management in the region, including those in neighboring countries.

Thus, success of realization of the project both in creation of geo-information support, and in carrying out of the spatial analysis and zoning of the territory by various features mainly depends on completeness of solving the following problems:

1. Definition of the general structure of GIS fitting the purpose and tasks of the project.
2. Coordination of elements (layers) of a geographical basis among themselves and along the state boundaries, including agreements about classifications.
3. Estimation of presence and degree of uniformity of the initial thematic data in the form of various cartographical images.
4. Coordination of elements of thematic layers, including coordination of their classifications with common geographic elements (layers) in frontier areas.
5. Use of uniform common geographic base in work of all working groups, coordination of newly received thematic information and its inclusion in uniform GIS.
6. Use of GIS opportunities to carry out the spatial analysis and various kinds of zoning.

Further, designing and creation of the Amur River basin's atlas is possible on the basis of GIS. It can be prepared in different variants, proceeding from the received results and available funds.

Variant 1 - a series of electronic maps in the raster formats grouped by themes with brief cover texts (CD).

Variant 2 - a series of electronic interactive maps, compiled from vector layers at choice with interactively changing legends on the basis of the reduced versions of ArcView modules (CD).

Variant 3 - its printed edition.

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