CREATION OF GIS FOR AMUR RIVER BASIN: THE BASIC GEOGRAPHICAL INFORMATION

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INTRODUCTION

According to the technical task of the contract between the Pacific Geographical Institute, FEBRAS and Research Institute for Humanity and Nature Inter-University Research Institute Corporation National Institutes for Humanities (Kyoto, Japan) the following works have been fulfilled:

1. Compiled electronic (digital) base common geographic coverages, including:
- Relief in horizontal lines every 300 meters.
- Hydrological network: main channels, tributaries, lakes, water reservoirs, channels.
- Settlements divided into: states capitals; centers of krais (oblasts), provinces; cities over 1 million, from 1million to 500 thousand, from 500 thousand to 100 thousand of residents.
- Road network: railways, motor roads: highway, other covered roads.
- Borders: state, administrative of krais (oblasts), provinces.

2. Made an electronic 3D-model of relief - DEM (using data of Shuttle Radar Topographic Mission (SRTM) with step of 15 arcsecond).

3. Created a map (electronic coverage) “Modern land-use in Amur River basin” on the basis of decoded satellite images of LANDSAT–TM 2000-2001 with resolution on the spot 50-100 meters.

4. Compiled an electronic coverage “Geological Structure”

5. Compiled an electronic coverage “Vegetation of Amur River basin”

RESULTS

Thus, all the works on geo-informational provisioning for the project have been fulfilled in two blocks, 1 – base general geographic one, and 2 – base thematic one. All the electronic coverages have been made on Arc/INFO, ArcView platforms in the detailed scale 1:2,500,000 of common projection of the following parameters:

projection albers
datum puk
units meters
spheroid krassovsky
52 0 0 /* 1st standard parallel

64 0 0 /* 2st standard parallel
135 0 0 /* central meridian

1. THE COMMON GEOGRAPHICAL COVERAGES

The common digital geographical coverages were created:

1. Relief in horizontal lines: 100, 200, 300, 400, 500, 600, 800, 1000, 1500, 2000, 2500 meters.
2. Hydrological network: main rives and channels, tributaries, lakes, reservoirs, channels.
3. Settlements: states capitals; centers of krais (oblasts), provinces; cities with population more 1 million, from 1million to 500 thousand, from 500 thousand to 100 thousand, from 10 thousand to 100 thousand.
4. Road network: railways, motor roads: highway, other hard covered roads.
5. Borders: state, administrative of krais (oblasts), provinces, aimaks.
6. Digital 3D model of relief was built using data of the Shuttle Radar Topographic Mission (SRTM) with step of 8 arcsecond (250m). Shuttle radar topographic mission (SRTM) – Radar topographic survey by the US Government. Accuracy – 90 meters, in height - 20 meters. URL ftp://e0srp01u.ecs.nasa.gov/srtm/version1/. Date of source data: February 2000.

Vector maps Vmap0 in scale 1:1'000'000 for the whole territory of Russia and China distributed by the USA National Geospatial Agency (NGA) were initial data for the main coverages. These data are available for downloading through special web-site (http://geoengine.nima.mil/geospatial/SW_TOOLS/NIMAMUSE/webinter/rast_roam.html)

Relief in horizontal lines and points of fixed height above sea level was made from digital model of relief (DEM). The data for all common geographical coverages have been corrected according to the base topographic maps in scale of 1: 1,000,000, published in 1975-1989. The data for settlements and roads have been corrected according to “The National Economic Atlas of China”, published in 1994.

2. THE COMMON THEMATIC COVERAGES

1. Map (electronic coverage) “Modern land-use in Amu River basin” (Fig. 1)

Mainly composite montages of average resolution of 30 m and over were used directly in the work. The resolution 30 m is rather redundant for receiving a final result in scale

1:2,500,000, therefore the resolution changed up to 50-100 m was applied for various territories. The images with resolution 15-30 m were used to specify some most disputable territories. Decoding was made in ArcView 3.3 by means of special extension Image Analysis to form shape files subsequently converted into the Arc/Info coverages. In addition to direct interactive expert decoding of satellite images to get reference and correcting information, the following sources like (1) The vegetation map of Amur River basin 1:2,500,000 edited by academician Sochava V.B. (1968), (2) The vegetation map of

Mongolian People's Republic 1:3,000,000(1990), (3) The Vegetation Atlas of China 1:1,000,000 (2001) converted into the electronic raster form were used.

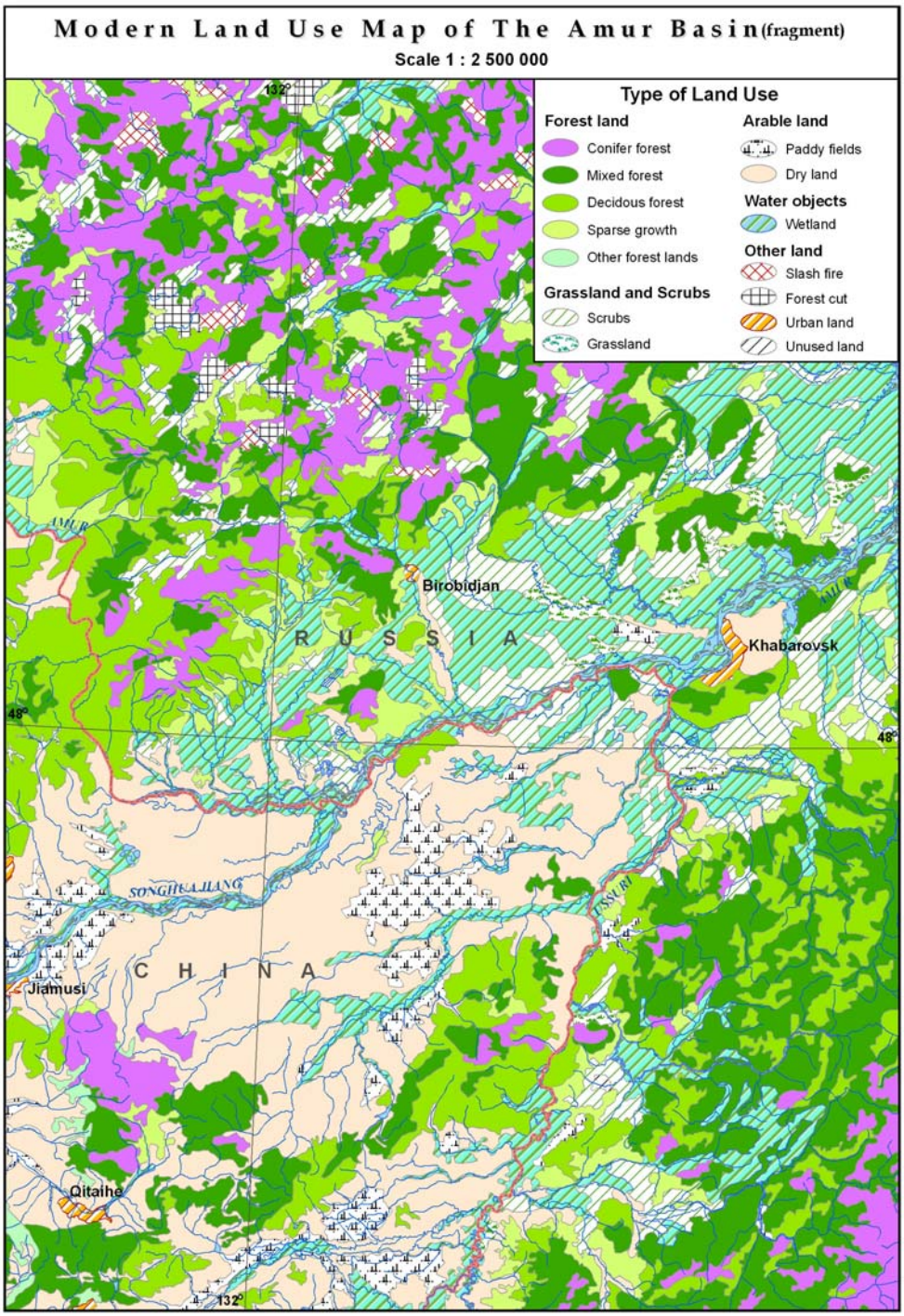


Figure.1

As a result of processing accessible primary sources, first of all, materials of remote sensing, the following categories of modern land-use have been revealed within the territory of the whole of Amur River watershed: forest lands, meadows and bushes, agricultural lands, water bodies, and other lands. These categories, in turn, are divided into types of modern land-use as object (information cell) of mapping. Since the scale of mapping is small enough, and a level of generalization is high, the types concept includes various kinds of land-use and

of natural state of lands. At that, a genesis of each type of lands is not considered; they can be formed through very different way.

The 'coniferous forests' type includes fur, abies, Korean pine, pine, larch forests and their versions. The 'mixed forest' type includes all transitive versions from coniferous to deciduous forests at their approximately equal ratio. The 'deciduous forests' type includes broadleaved and small-leaved forests and their versions. The 'sparse forests' type includes rare forests of various composition, alternation of woods with bushes with density of stands less than 30 %. At that, as already mentioned above, the genesis of this type of lands is not considered; they can be formed after fires, loggings, etc. The 'other forests' type includes forest plantations, including, industrial ones.

The category 'meadows and bushes' embraces types - meadows, bushes, by-golets bushes with high-mountainous tundras. The 'bushes' type includes bush, meadow and bush lands, and partly, bush and sparse forested lands at prevalence of bush vegetation. The 'meadows' type is rather variable, and at the given stage of studies it includes any grassy vegetation - actually meadows, steppes, etc. The 'golets bushes with high-mountainous tundras' type includes mountainous pine, dwarf forms of high-mountainous bushes, tundras, goletses.

The 'agricultural lands' category embraces types - reclaimed and not reclaimed agricultural lands. The 'reclaimed lands type includes mainly paddy fields, and the type 'not reclaimed lands' - arable lands, fallow lands, haymaking sites, pastures.

The 'water bodies' category embraces lakes, water reservoirs, swamps. The 'wetland' type includes various kinds of swamps: high bogs, mari, etc., and also water-logged flooded meadows and marches.

Fire-sites and loggings at places of former forests, residential areas (large settlements), industrial and unused lands (quarries, slag-heaps, etc.) enter to the category 'other lands'.

2. Electronic coverage “Geological structure” (Fig. 2)

Electronic coverage “Geological structure» was formed on the basis of “Geological map of Pri-Amurye and adjacent territories by scale 1: 2,500,000” printed 1999 and “The Geological map by scale 1: 3,000,000 from Atlas of Mongolian People’s Republic”, 1990.

The coverage reflects a distribution of geological bodies in details corresponding to the scale 1:2,500,000. Every geological body is aged at the level of system, and partly at the level of section. The rocks are divided by their composition into intrusive, volcanogenic, sedimentary ones and metamorphic. Intrusive and volcanogenic rocks are presented in more details. Thus, granites are divided into granitoids, diorites, gabbroids, ultrabasites, alkaline and partially more detailed, e.g. granitoids include: granites, granodiorites, monzogranites, granosyenites. Volcanogenic rocks by composition are divided into sour, middle, basic, alkaline, mixed. Tectonic fractures are divided into mantle, lithospheric, crusty, which, in turn, are divided into covered and not covered by sedimentary strata.

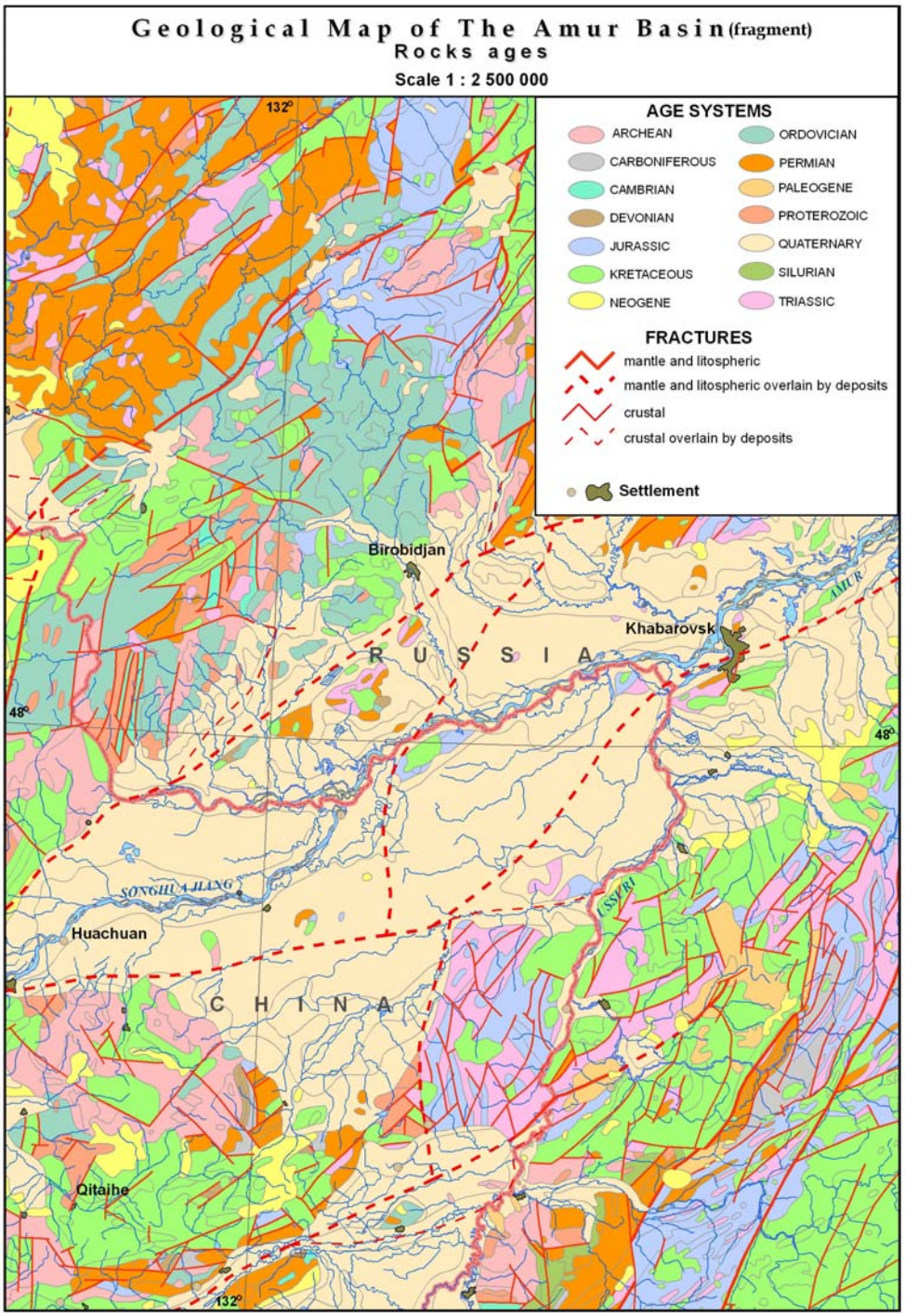


Figure.2

3. Electronic coverage "Vegetation of Amur river basin" (Fig. 3)

Goal of the work is to compile a map of vegetation of Amur River basin on the basis of unified description.

Used sources: 1. The vegetation map of Amur River basin 1: 2,500,000 edited by academician Sochava V.B. (1968). 2. The vegetation map of Mongolian People's Republic 1: 3,000,000 (1990). 3. The Vegetation Atlas of China 1: 1,000,000(2001). The legends (descriptions) to these maps had been made on the basis of different approaches.

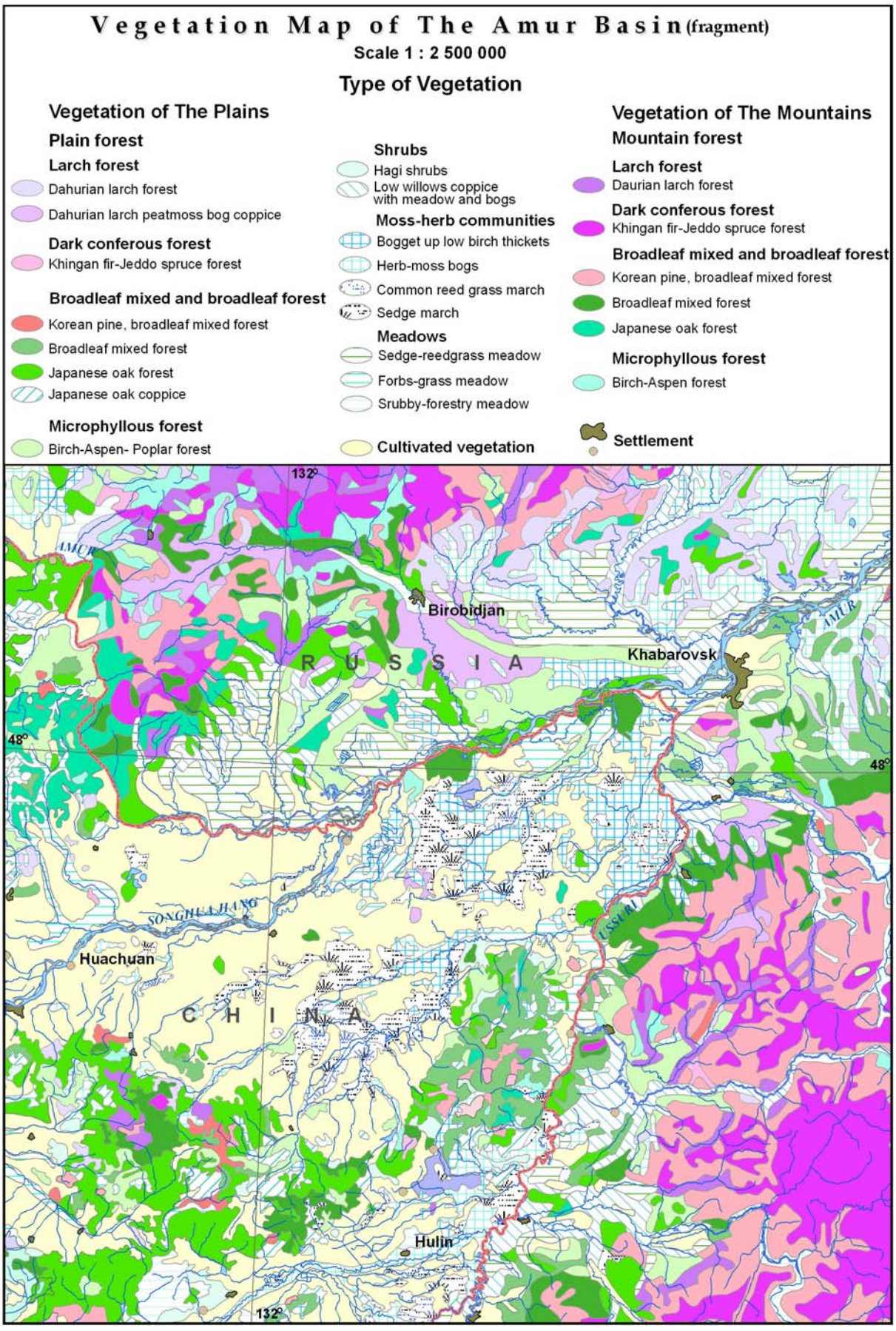

Vegetation Map of The Amur Basin (fragment)
Scale 1 : 2 500 000
Type of Vegetation
Vegetation of The Plains
Plain forest
Larch forest
Dahurian larch forest
Dahurian larch peatmoss bog coppice
Dark conferous forest
Khingan fir-Jeddo spruce forest
Broadleaf mixed and broadleaf forest
Korean pine, broadleaf mixed forest
Broadleaf mixed forest
Japanese oak forest
Japanese oak coppice
Microphyllous forest
Birch-Aspen- Poplar forest
Shrubs
Hagi shrubs
Low willows coppice with meadow and bogs
Moss-herb communities
Bogget up low birch thickets
Herb-moss bogs
Common reed grass march
Sedge march
Meadows
Sedge-reedgrass meadow
Forbs-grass meadow
Srubby-forestry meadow
Cultivated vegetation
Vegetation of The Mountains
Mountain forest
Larch forest
Daurian larch forest
Dark conferous forest
Khingan fir-Jeddo spruce forest
Broadleaf mixed and broadleaf forest
Korean pine, broadleaf mixed forest
Broadleaf mixed forest
Japanese oak forest
Microphyllous forest
Birch-Aspen forest
Settlement
132°
48°
Birobidjan
Khabarovsk
RUSSIA
AMUR
SONGHUA JIANG
USSURI
Huachuan
CHINA
Hulin

Figure.3

Fulfillment of the set task required a uniform legend which would reflect the basic geographical rules of vegetation distribution within the Amur River basin. Besides that, it was necessary to generalize a map for the Chinese part of the basin. The legend developed under leadership of Sochava V.B. has been taken as its basis. A group of associations as the main mapped unit of this legend has been enlarged to the level of a formation to unify the data. Besides that, a dividing into vegetation of plains (zonal division) and mountain territories (height and zonal distribution of vegetation) has been made in the course of generalization for the Chinese part of the basin. The steppe vegetation has been divided into two types according to the attributes of vegetation namely: meadow steppes and sod-cereal steppes. It is quite admissible since steppes remained in separate small islands among tracts of mastered lands on the plains, and sod-cereal steppes locate mainly on heights over 500 meters above sea level. The ecological and dynamic rows have been allocated for river valleys which vegetative cover differs in great diversity. It seems that this way of displaying vegetation of river valleys increases a degree of clearness of the map. The agricultural lands on the whole territory are shown by one sign. In the territory of Mongolia entering into the Amur River basin, agriculture is not developed at all, and pastures occupy very small area. This way of displaying agricultural lands seems to allow someone to see a degree of territories' mastering.

The compiled map of vegetation shows a variety of modern vegetative communities and rules of their distribution. Their distribution reflects zonal (in plains) and height-zonal (in mountains) changes of vegetative cover on this great territory which is complex by combination of natural conditions. Totally, the legend includes 69 types describing the basic formations of forests, meadows, steppes, bogs, shrub thickets and agricultural lands on plains and mountains of the Amur River basin. There are two short parts of vegetation classification (legend) as examples below:

Vegetation on the low lands, plains and low plateau

Larch forests

Dahurian larch (*Larix dahurica=L. gmelinii*) forests

Common pine (*Pinus silvestris*) - Dahurian larch forests

Japanese oak - Dahurian larch forests

Birch (*Betula platyphylla*)- Dahurian larch forests

Dahurian larch peatmoss bog coppice

Korean Dahurian larch (*Larix olgensis*) forests, including artificial forests

Korean Dahurian larch peatmoss bog coppice

Dark coniferous forests

Common pine (*Pinus silvestris*) forests, including artificial forests

Khingan fir- Jeddo spruce (*Picea jezoensis, Abies nephrolepis,* locally with *Picea obovata*

Khingan fir- Jeddo spruce with Koyama spruce (*Picea koraiensis*) forests

Mountain vegetation

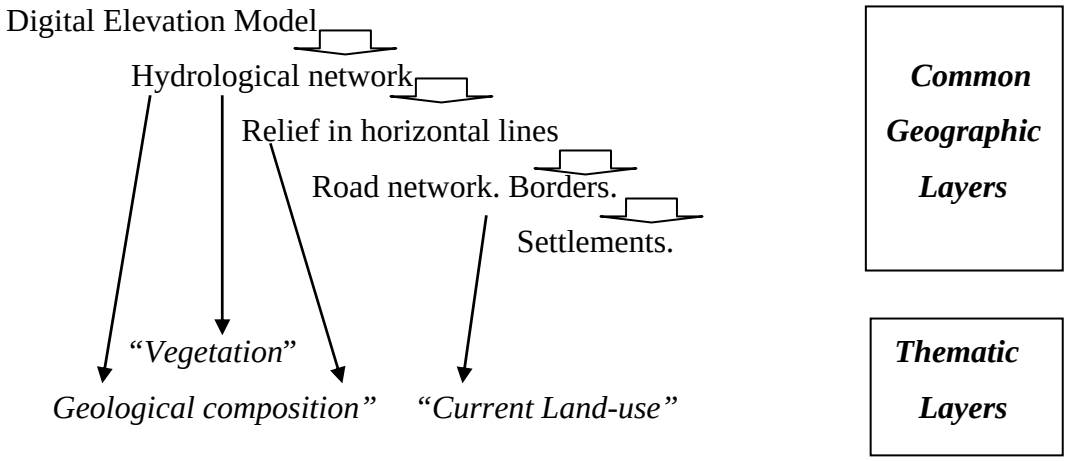
Mountain forests

Larch forests

Dahurian larch forests
Common pine (*Pinus silvestris*) - Dahurian larch forests
Japanese oak - Dahurian larch forests
Birch (*Betula platyphylla*)- Dahurian larch forests
Korean Dahurian larch forests, including artificial forests
Korean Dahurian larch sphagnum bog coppice
Siberian larch forests

All the information coverages having common borders and/or direct relations sequentially and conceptually are conformed to each other in much the same way in complex and atlas cartography making the through spatial rows. Practically every row has at least one spatial intersection with others. Thus, most coverages have common invariants directly or implicitly.

Sequence of the coordination of digital layers for Amur basin GIS



CONCLUSION

The cartographical assessments of various components received in the course of fulfilling the project enable to reveal the main features of differentiation and disturbance of the natural environment in Amur River watershed, and to define the areas playing a key role in changing of dissolved iron coming into the Sea of Okhotsk watershed. At present, the work on compiling an electronic coverage and relevant database and soil map comes to an end.

From our point of view, continuation of the works on creation of GIS for Amur River watershed demands more detailed assessments on middle and probably on large-scaled level of several key areas: watersheds of the rivers being inflows of Amur River, subjected to considerable anthropogenous impact and transformation (for example, Anyui River watershed, lower reaches of Zeya River).

It is supposed to continue also works on drawing up an electronic coverage (and then a map) of landscape composition of Amur River watershed. It will allow us to assess the natural

situation fully, on the one hand, and, on the other hand, to carry out more correct planning of nature conservation and nature management actions within the watershed.

REFERENCES

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