An aerial photograph of the Russian part of the Amur River basin, outlined in yellow. The map shows a mix of green forested areas and brown agricultural fields. A large blue lake is visible in the upper center. The city of Vladivostok is marked with a red dot and labeled, with two islands, Ostrov Russkiy and Ostrov Putyatina, also labeled. Two blue airplane icons are placed on the map. The word 'Primorsky' is visible in the top right corner.

Classification and landscape mapping of the Russian part of Amur River basin

Ganzei K.S., Ermoshin V.V.
Pacific Geographical Institute FEB RAS
Centre of Information and Cartography
RUSSIA

Object of Investigation

Russian Part of Amur River Basin



The Amur River Basin is the largest international trans-boundary geosystem of sub-regional level in Northeastern Asia. It belongs to the rivers flowing into the Pacific Ocean, and it has the watershed area about 2,000,000 sq. km

Information basis of investigation

- *DEM - Digital Earth Model by using Remote Sensing Dates SRTM (RadarSat) was made;*

Digitalized, redacted and united:

- **Main geographical information layers: rivers, roads, borders, settlements and other;**
- **Thematically information layers: geological, vegetation, soil, geomorphological;**
- *«Modern Land Use of Amur River Basin»;*

«Environmental Criteria and Restrictions in the Programs for Sustainable Nature Management in the Amur River Basin»

Project #4008 of the International Science and Technological Centre

Project goal.

The planned project implementation involves analysis of environmental condition of the Russian part of the Amur River basin, development of a system of environmental criteria and restrictions of the economic activities and land use in the Russian part of the Amur River basin to substantiate sustained nature management, to forecast and assess possible changes and to develop measures for improvement and preservation of high quality of the environment and regeneration of renewable resources.

Scope of Activities.

- general physical and geographical description and assessment of natural resource potential of the Russian part of the Amur River basin;
- socio-economic description and assessment of the basic types of nature management in various parts of the territory;
- cause-consequence analysis of the environmental problems and hazards, forecasts of possible changes in the environmental condition;
- **creation of landscape map of the territory, assessment of disturbance and pollution level, natural and nature resource environment;**
- landscape-geochemical zoning of forest and wetland ecosystems of the Russian part of the basin on the basis of data on input of water-dissolved iron;
- development of the ecological-economical balance model in the programs of sustained nature management of basin geosystems;
- development of the system of environmental criteria and indexes of sustained nature management on the basis of analysis of landscape structure of the territory, implementation of functional zoning, compiling of corresponding maps and diagrams;
- preparation of definite proposals on improvement and preservation of high quality of the environment;
- preparation of organizational proposals for the efficient implementation of the project recommendations.

Landscape map is an informational basis for making a functional zonation and planning of the sustainable development, definition of the priority, possible and forbid types of land use for planning the nature and economic activity in the Amur River basin.

Results of the landscape investigations:

Electronic layers of the landscape complexes and landscape-geochemical zonation, which must shown for Amur River basin peculiarities of the landscape structure.

According to the project goal the scale of the landscape mapping – 1:2 500 000

Analyzes of the landscape structure allow to classify the landscapes by the them anthropogenic sensibility

in the different physical-geographical zones of Basin.

Landscape mapping works carried out on the basis of synthesis the thematic information layers.

Landscape classification

Matrix form for the landscape classification were used.

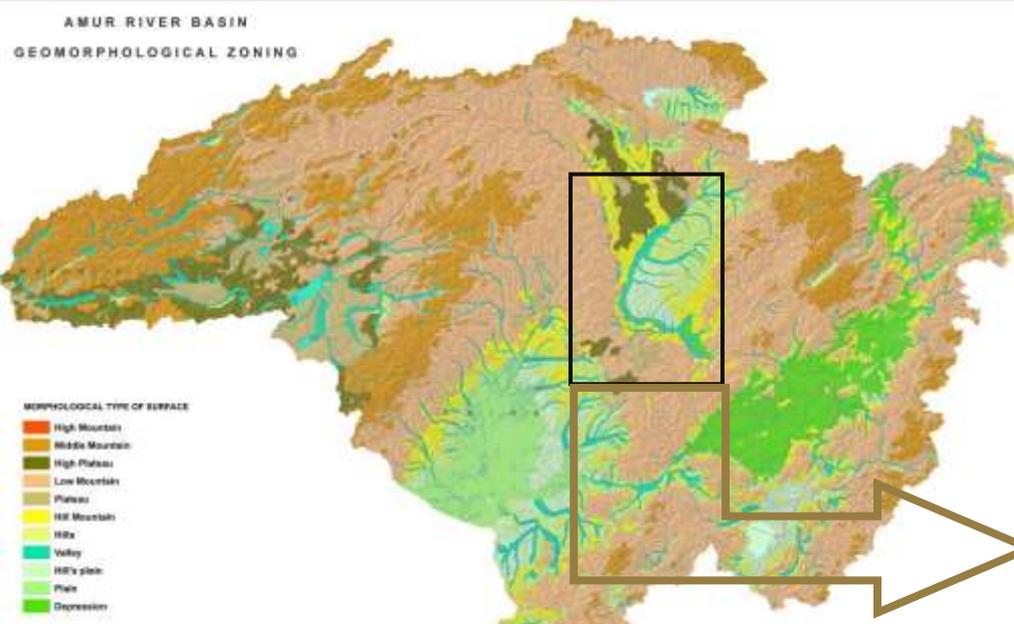
Matrix classification give a possibility to analyzed the interrelation and interdependent landscape compounds and show the peculiarities of the landscape structure of the territory.

Methodology classification basis.

For the development of the landscape classification the structure-genetic type classification were used*.

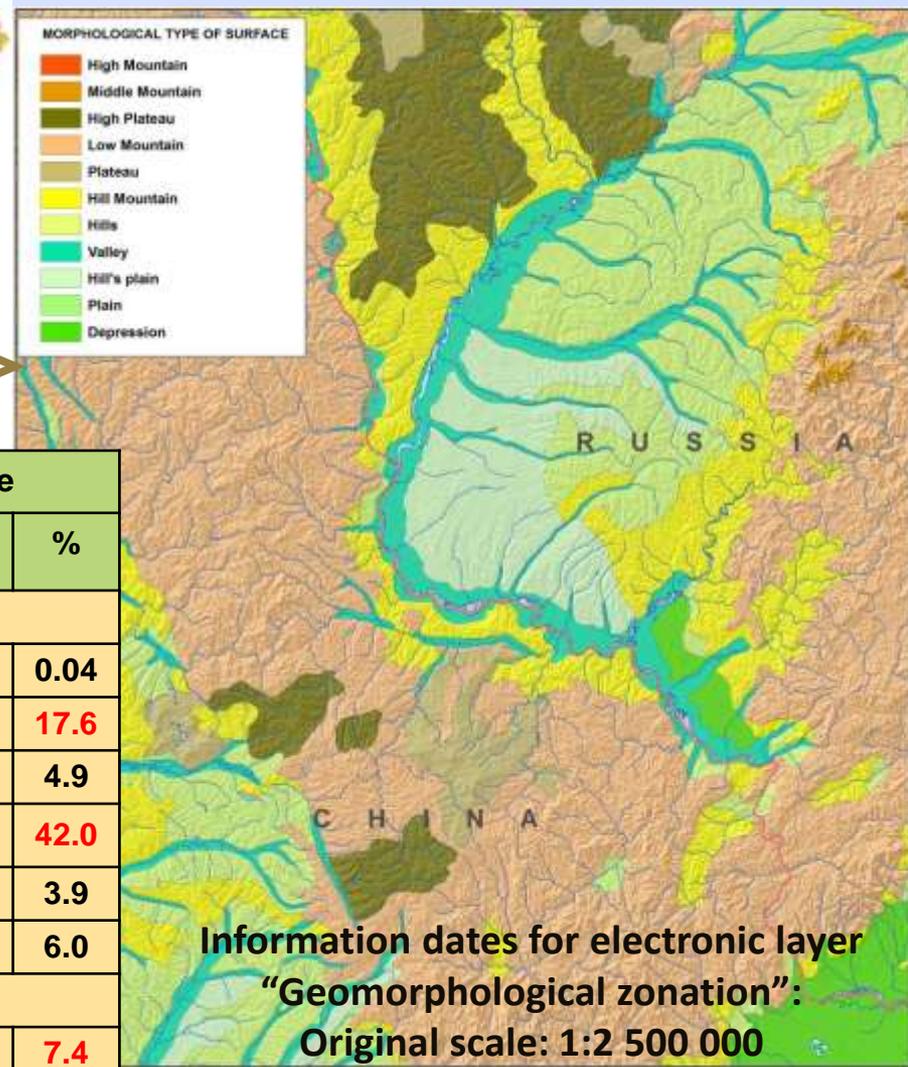
This classification type have established on the **4 principles**:
historical, genetic, structural and regional.

*Nikolaev V.A. Problems of regional landscape science. Moscow: Moscow State University, 1979. 160 p.



First step

Analysis of geomorphological structure

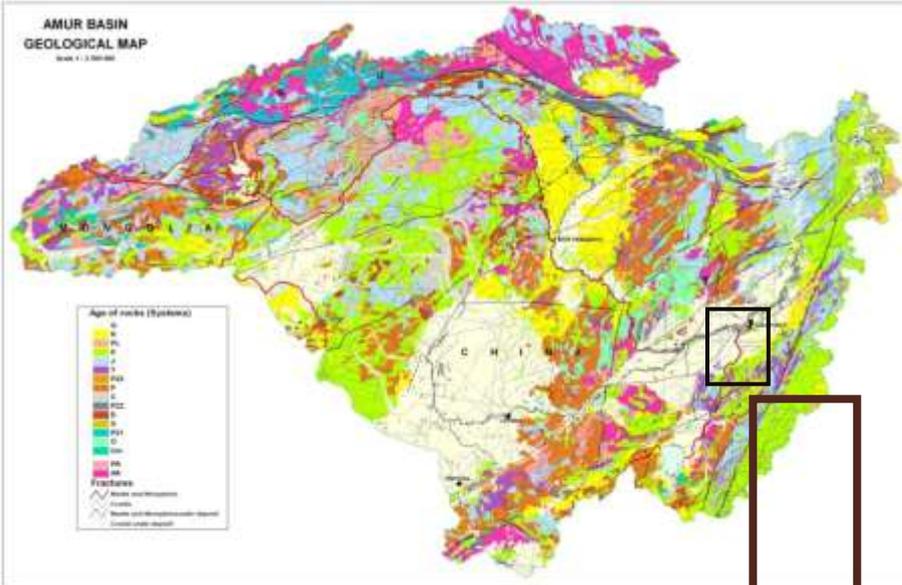


Geomorphological type	Elevation (meters)	Slopes (degrees)	Square	
			Th. sq. km.	%
Mountain relief				
High mountain	more1800	15 - 45	0.8	0.04
Middle mountain	850 - 1800	12 - 25	361.5	17.6
High plateau	600 - 1500	5 - 12	100.4	4.9
Low mountain	300 - 900	10 - 20	861.6	42.0
Plateau	300-900	2 - 5	79.1	3.9
Hill mountain	200 - 400	4 - 10	122.7	6.0
Flat relief				
Hills	100 - 300	2 - 5	152.3	7.4
Plain	50 - 300	0 - 3	140.6	6.9
Depression	0 - 150	0 - 1	101.0	4.9
Valley	0-200, 500-800	0 - 2	117.8	5.7

1. Digital Earth Model , with using SRTM
2. Topographical map in scales 1:1 000 000 and 1:200 000

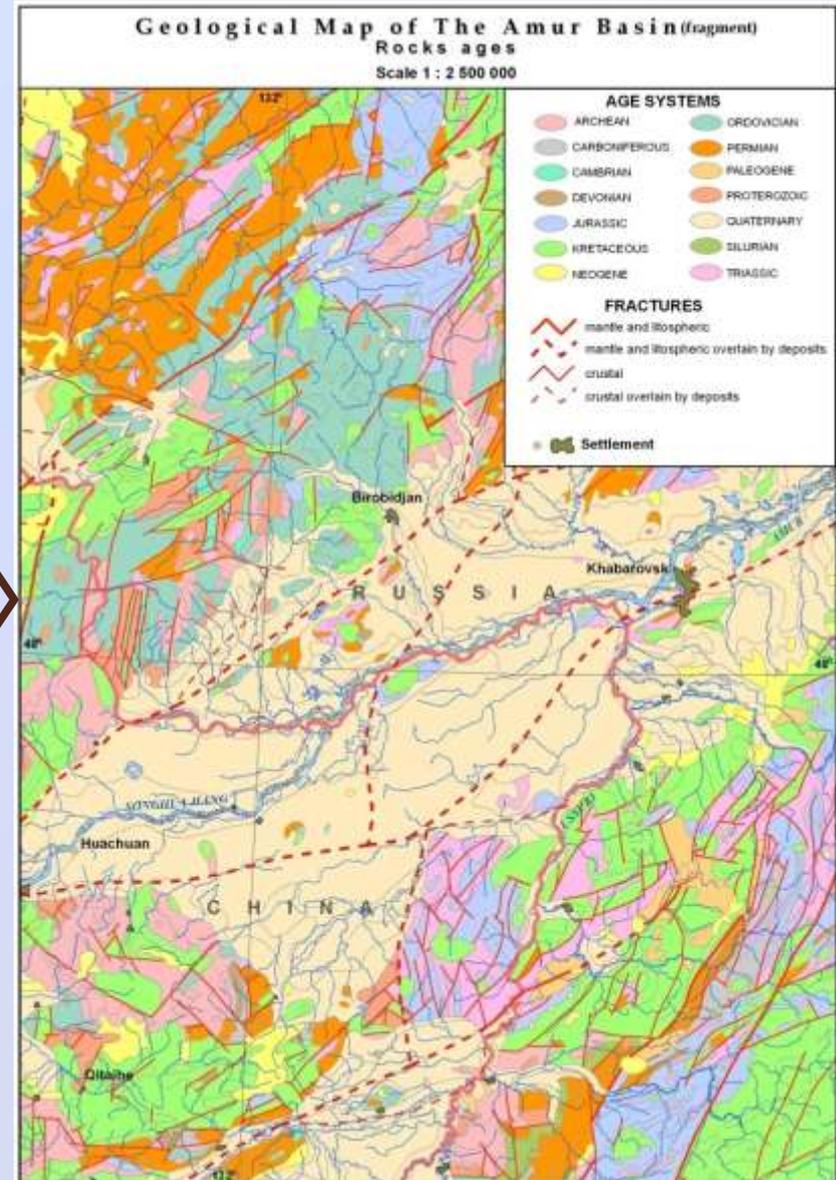
Second step

Analysis of geological structure



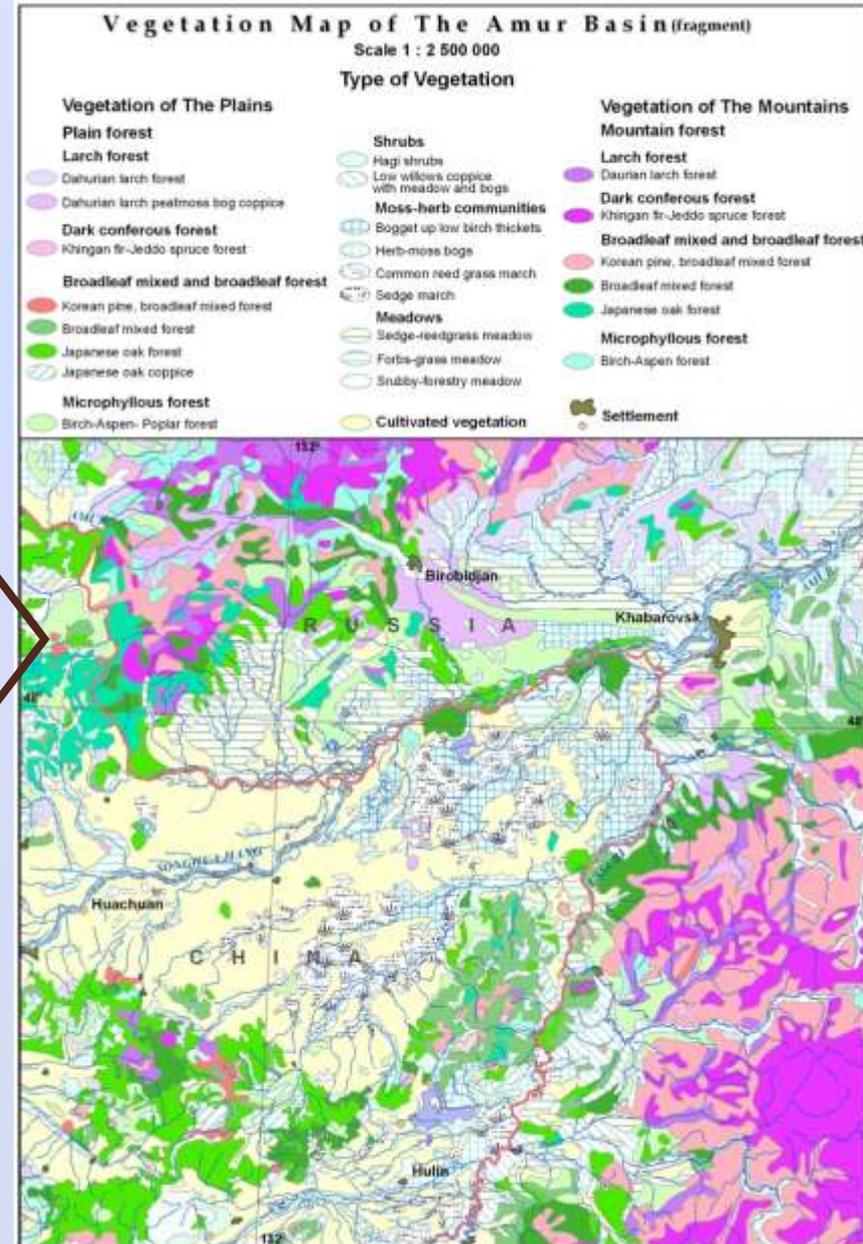
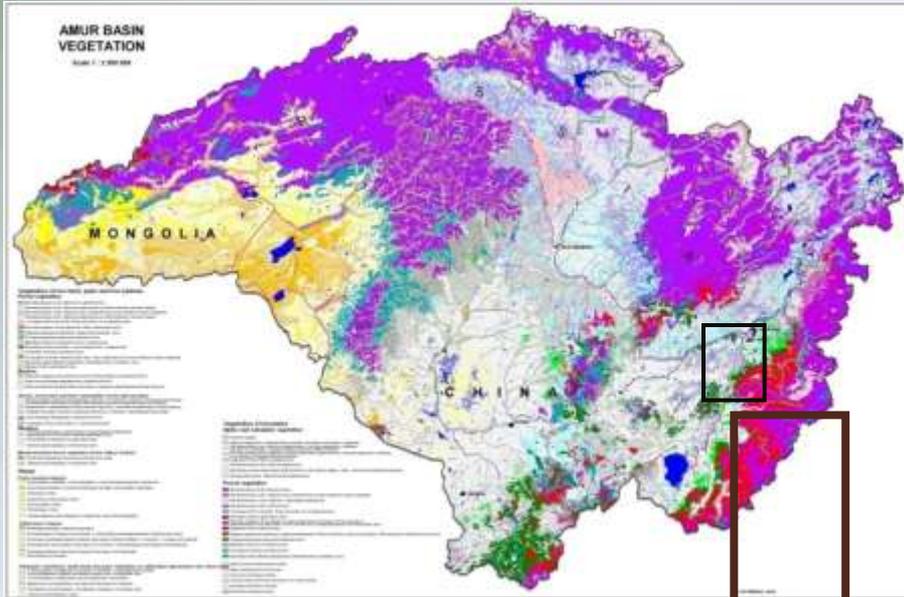
Geological Map of the Amur River Basin Original Scale 1: 2 500 000

The rocks are divided by their composition into intrusive, volcanogenic, sedimentary ones and others (10 types of composites).



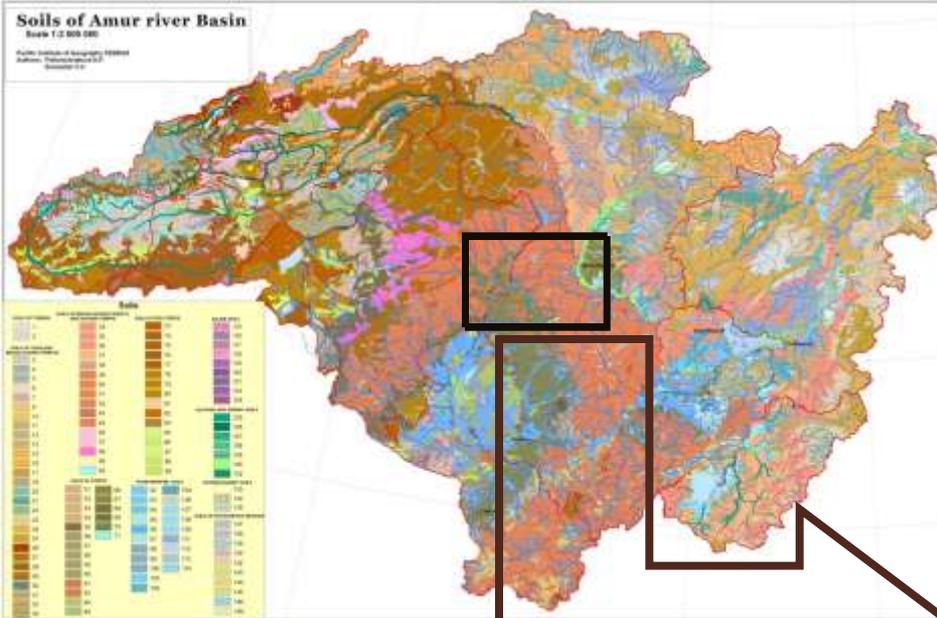
Third step

Analysis of vegetation structure



Vegetation Map of the Amur River Basin Original Scale 1: 2 500 000

The compiled map of vegetation shows a variety of modern vegetative communities. Their distribution reflects zonal (in plains) and height-zonal (in mountains) changes of vegetative cover . The legend includes more than 39 types describing the basic formations of forests, meadows, steppes, bogs, shrub and agricultural lands on plains and mountains of the Amur basin.

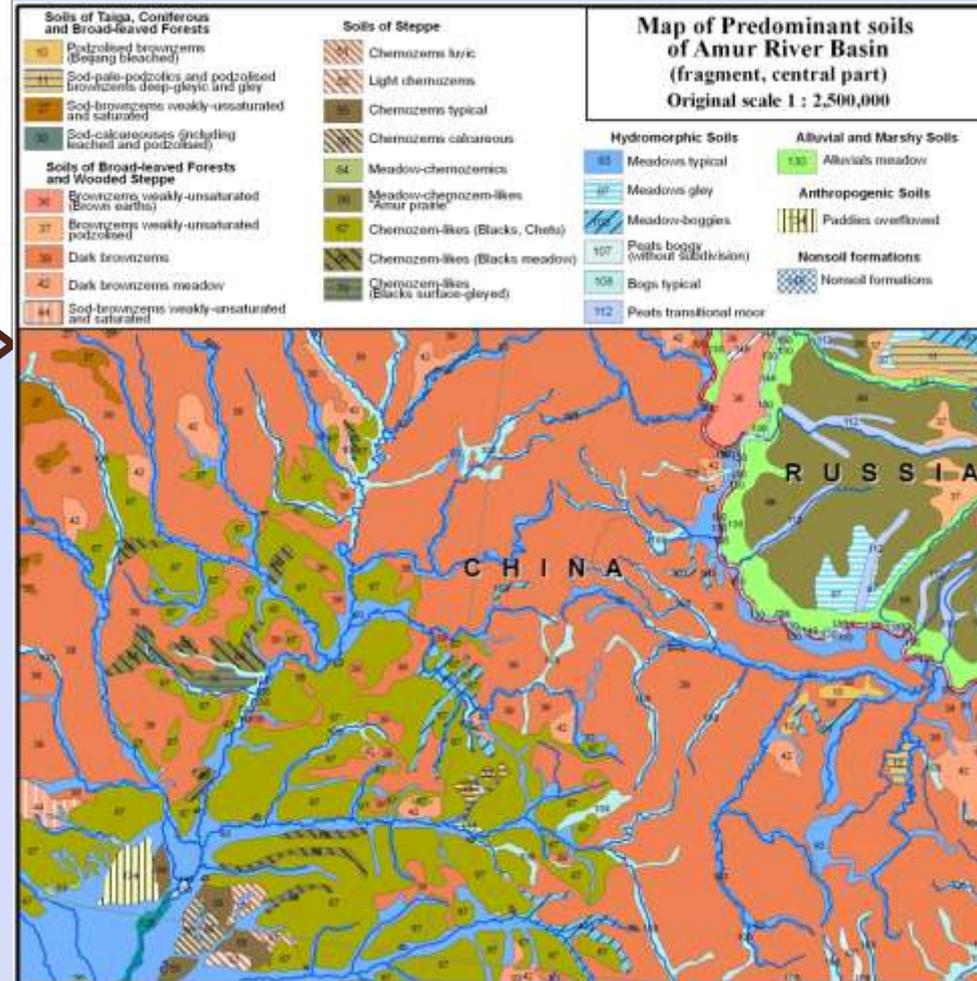


Soil Map of the Amur River Basin
Original Scale 1: 2 500 000

The classification includes 9 main classes of soils. There are: soils of tundra, soils of taiga and coniferous and broad-leaved forests, soils of broad-leaved forests and wooded steppe, soils of steppe, soils of dry steppe, hydromorphic soils, saline soils, alluvial soils, anthropogenic soils, soils of mountainous regions. Classes were divided at more than 150 types.

Fourth step

Analysis of soil structure



By the result of the landscape classification were separated **583 types of landscapes** with characteristics of the geological, geomorphological, vegetation and soil components.

Fragment of the matrix landscape classification of the Russian Part of Amur River basin

Vegetation and soils	Geology and geomorphology				
	Flat		Mountain		
	Hills		Mountain hills	Low mountain	
	Volcanogenic-sediments formation	Neogene-Quaternary sediments	Metamorphic rocks	Gabbroid rocks	Volcanogenic rocks
FORESTS					
Light coniferous forests					
Larch					
<i>On floodplain meadow soils</i>	1				10
<i>On brownified-humic and illuvial-humic soils</i>	2	4	6		
Oak-Larch					
<i>On brownified and gley soils</i>			7	9	
Dark coniferous forests					
Fir-spruce					
<i>On brownified, humic and illuvial soils</i>	3		8		11
SCRUB AND GRASS VEGETATION					
Scrubs					
Sallow open woods with grasslands and lowland swamps and oak-birch forests					
<i>On podzol-brownfoed-meadow soils</i>		5			

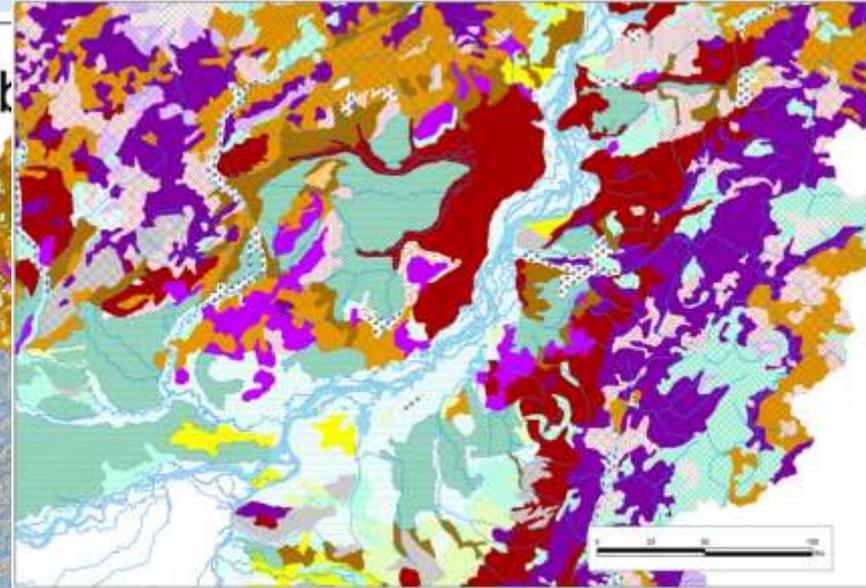
On the basis of landscape classification the landscape mapping in scale 1:2 500 000 of the Russian Part of the Amur River basin were made.

Electronic layer “Landscape complexes” contain 5042 polygons.

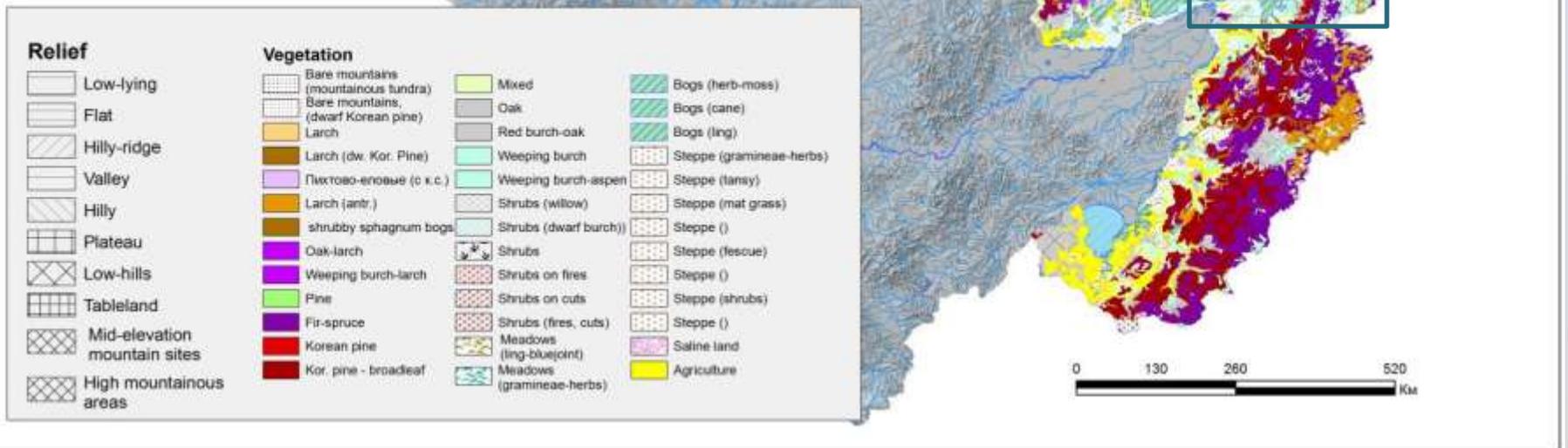
Maped area (sq.km)	Number of polygons	Number of landscape types	Average polygon area (sq.km)	Average number of polygons on the 1 landscape type (sq. km)
1009846,32	5042	673	200,29	7,5

Landscape of Amur Basin. Russian part.

Landscapes. Russian part of Amur k



The landscape map constructed reflects reliably the current state of natural objects within the Amur River basin.



Landscapes of the Flat territories of the Amur River basin (Russian part)

Relief	Area, sq.km.	Area, %	Dominant vegetation	Area, sq.km.	Area, %
Flat relief					
Low lands	47613,08	4,71	Grassley-moss swamp	24937,47	52,38
			Larch open woods on the slump lands	6316,52	13,27
			Agriculture lands	4157,44	8,73
Planes	4965,52	0,49	Agriculture lands	1596,25	32,15
			Sedge swamp	1452,61	29,25
			Sallow open woods with grasslands and lowland swamps and oak-birch forests	728,05	14,06
Hills	18479,08	1,83	Agriculture lands	13750,47	74,41
			Larch open woods on the slump lands	1996,3	10,8
			Grassley-moss swamp	1007,3	5,45
Valleys	60326,52	5,97	Grass lands	21018,19	34,84
			Agriculture lands	10460,31	17,34
			Larch open woods on the slump lands	10199,05	16,91
Ridges	77052,97	7,63	Larch open woods on the slump lands	22395,67	29,07
			Agriculture lands	12756,46	16,56
			Common birch and larch forests	9330,18	12,11

Landscapes of the Mountain territories of the Amur River basin (Russian part)

Relief	Area, sq.km.	Area, %	Dominant vegetation	Area, sq.km.	Area, %
Mountain relief					
Hill mountain	60968,43	6,03	Common birch and larch forests	13441,52	22,05
			Larch forests	9842,16	16,14
			Oak forests with open forests	4570,2	7,5
Plateau	16564,4	1,64	Agriculture lands	7843,46	47,35
			Larch forests	2390,01	14,43
			Larch open woods on the slump lands	1854,31	11,19
Low mountain	492420,9	48,73	<u>Larch forests</u>	<u>223112</u>	<u>45,31</u>
			Fir-spruce forests	62463,71	12,69
			Cedar-large-leaved forests	33698,28	6,84
High plateau	29103,43	2,88	Larch forests	7310,91	25,12
			Larch open woods on the slump lands	6812,43	23,41
			Pine forests	4858,57	16,69
Middle mountain	199863,9	19,78	<u>Larch forests</u>	<u>121881,1</u>	<u>60,98</u>
			Fir-spruce forests	26092,74	13,06
			Dwarf-pine	10223,43	5,12
High mountain	79,93	0,01	Mountain tundra	79,93	100

Anthropogenous influence on the landscapes:

Anthropogenous transformed lands – 15655,1 sq.km or (15,51 % area of basin)



Forests cutting

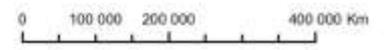


Forest fire



Area of agriculture lands – 86134,17 sq.km.

Tributaries between
Shilka and Zeya Rivers



Amgun' River Basin

Shilka River Basin

Zeya River Basin

CHINA

Argun' River Basin

Bureya River Basin

Low Amur

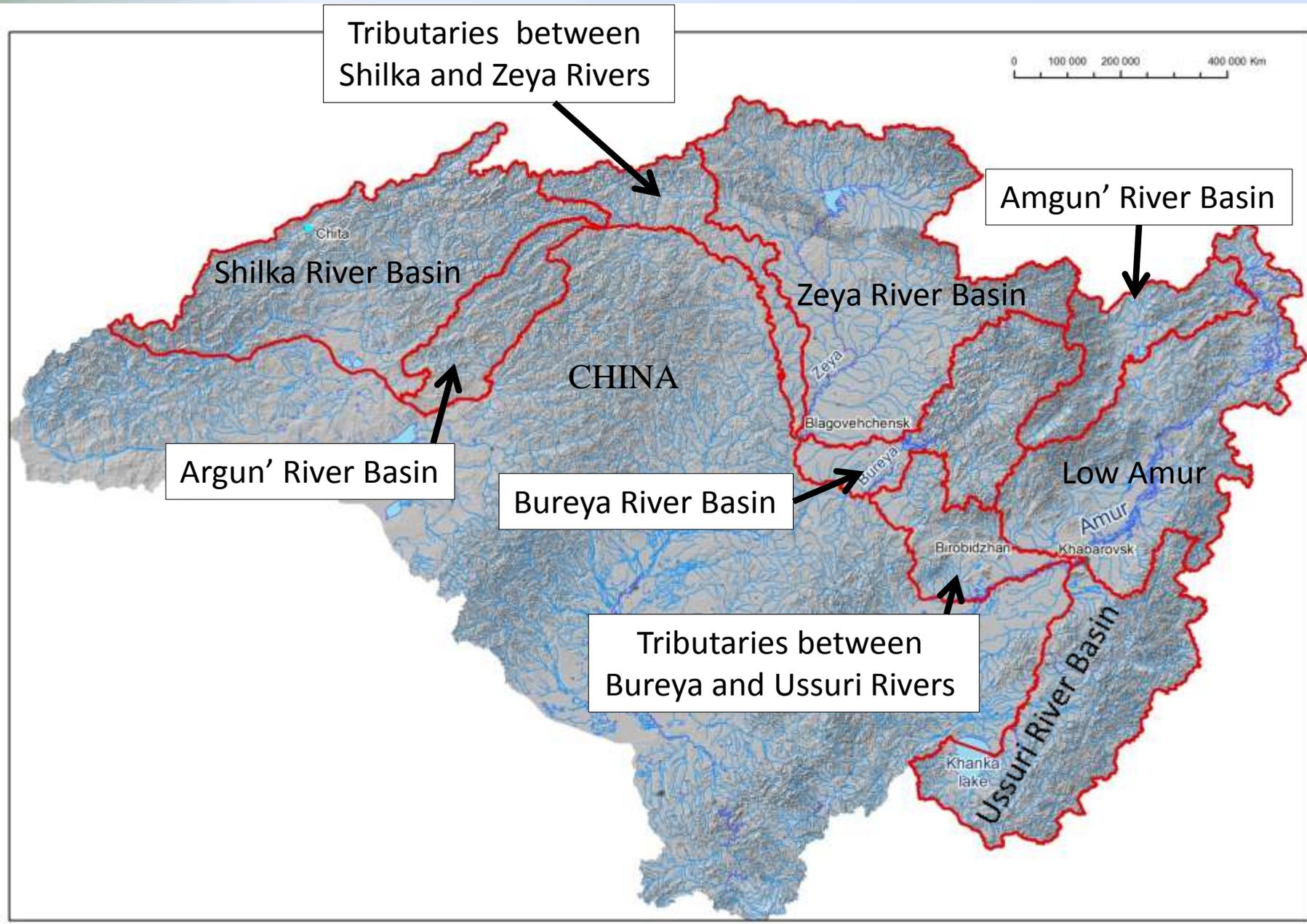
Tributaries between
Bureya and Ussuri Rivers

Birobidzhan

Khabarovsk

Khanka
lake

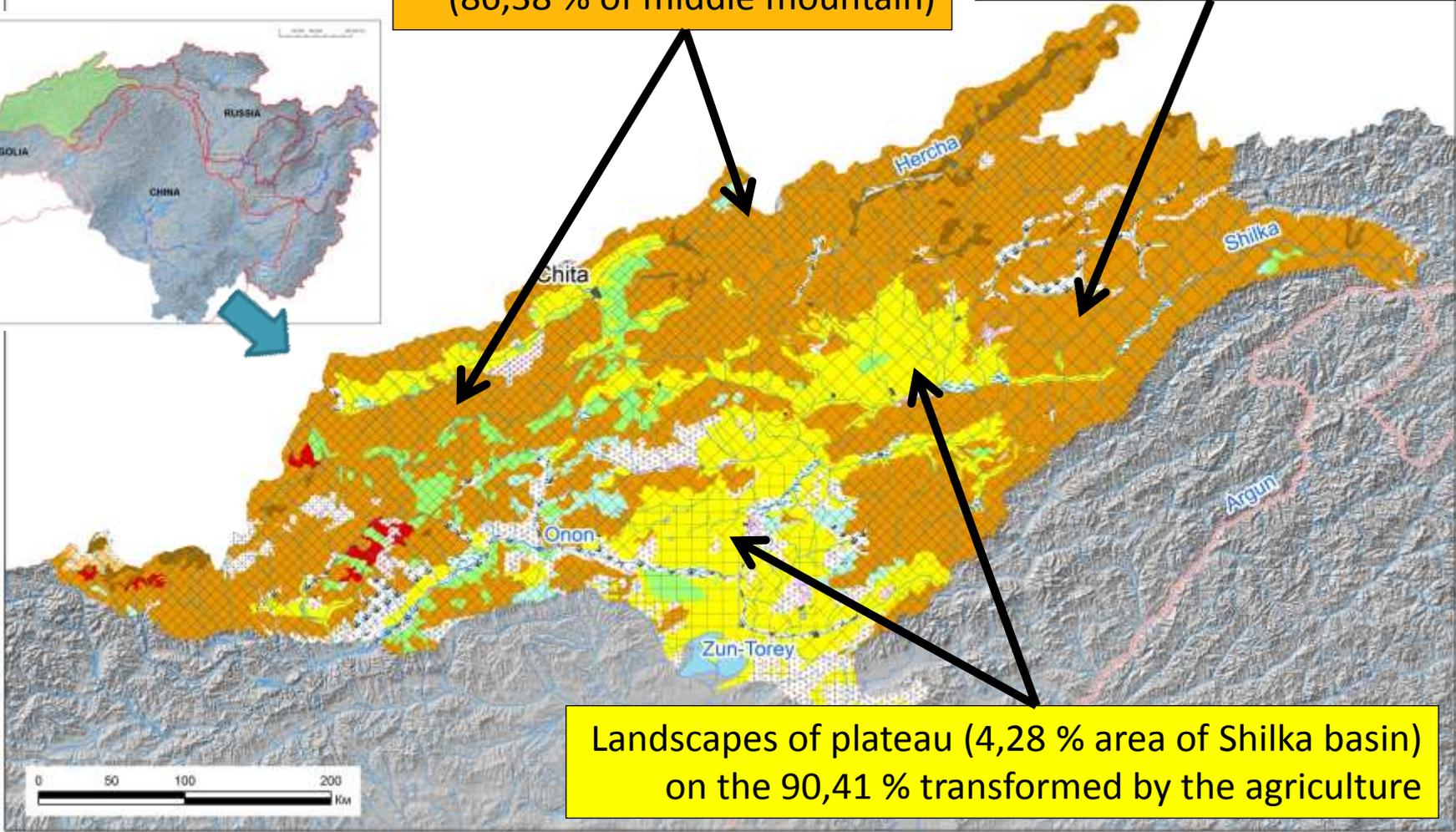
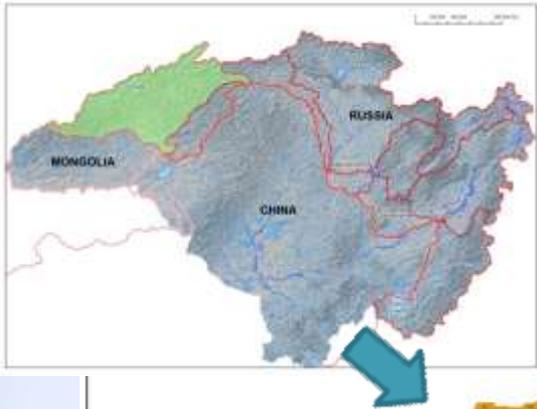
Ussuri River Basin



Landscape map of the Shilka River basin

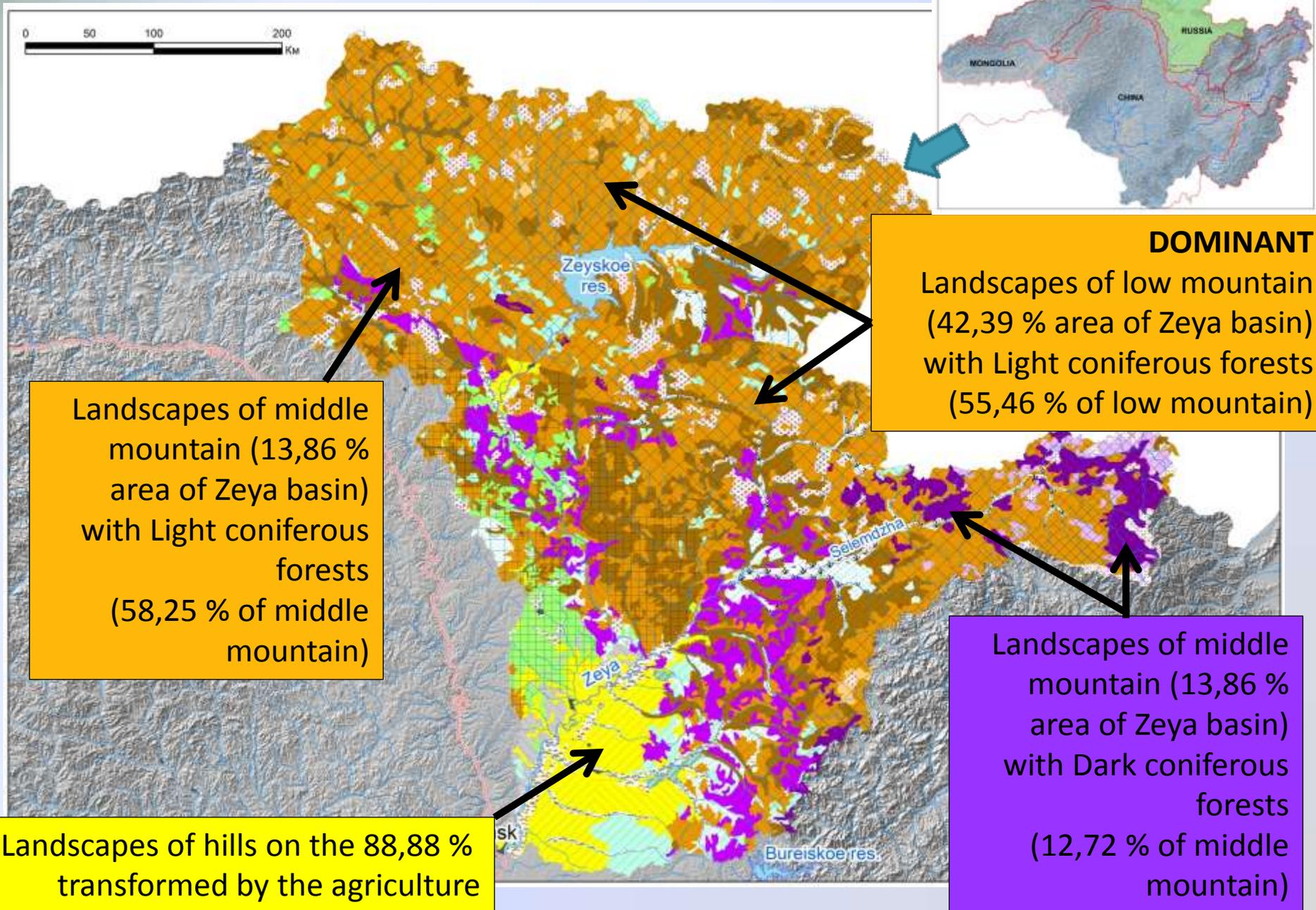
Landscapes of middle mountain (48,59 % area of Shilka basin) with Light coniferous forests (86,38 % of middle mountain)

Landscapes of low mountain (42,39 % area of Shilka basin) Light coniferous forests (55,46 % of low mountain)

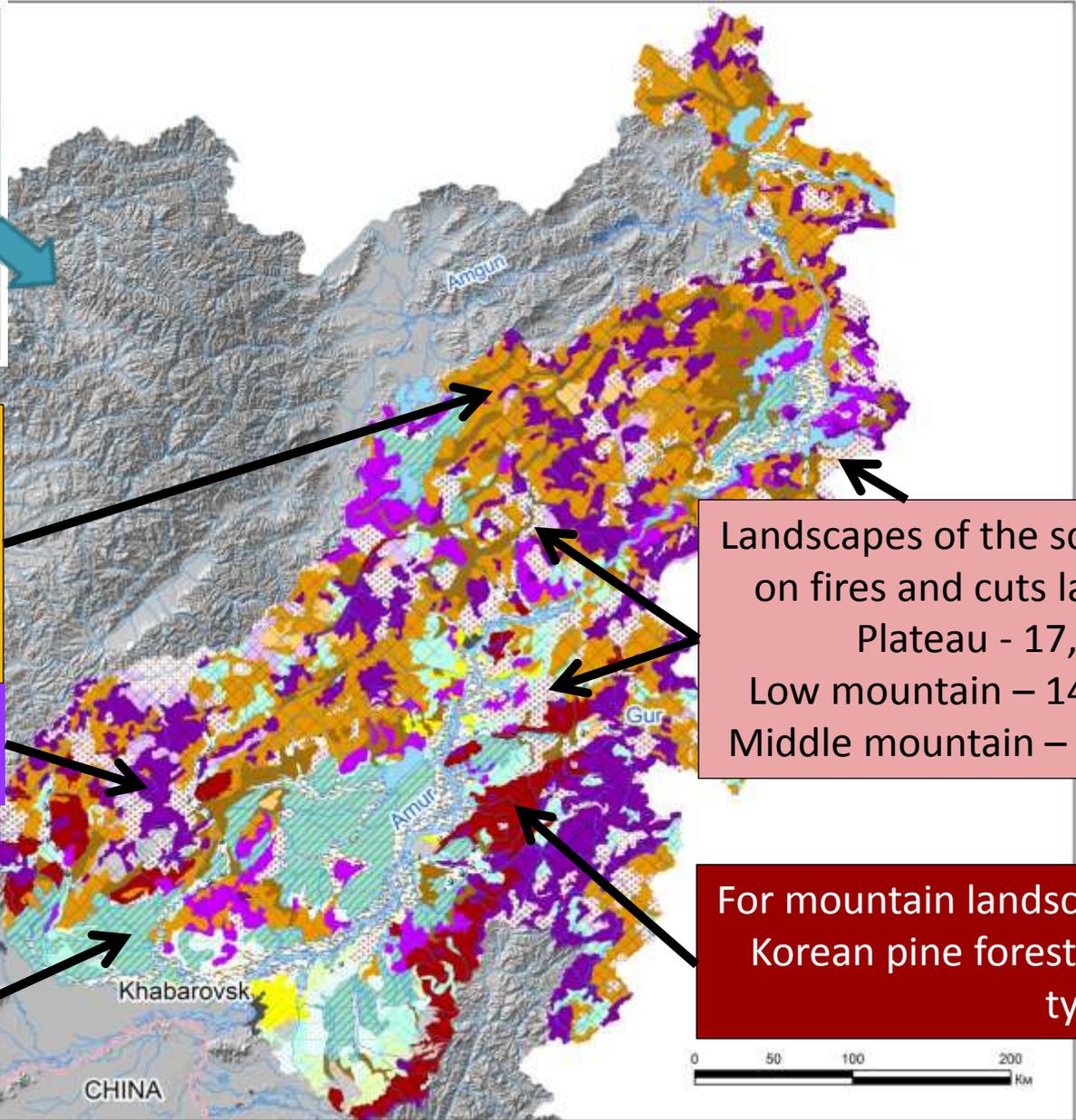
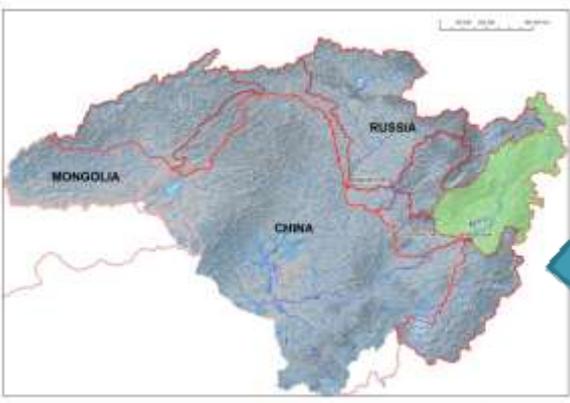


Landscapes of plateau (4,28 % area of Shilka basin) on the 90,41 % transformed by the agriculture

Landscape map of the Zeya River basin



Landscape map of the Low part of Amur River basin



DOMINANT

Landscapes of low mountain (42,39 % area of Zeya basin) with Light coniferous

and dark coniferous forests (29,24 % of low mountain)

Landscapes of low lands (16,95 % area of Low part of Amur basin) with bogs (56,2 % of low lands)

Landscapes of the scrubs on fires and cuts lands:
Plateau - 17,82 %
Low mountain – 14,9 %
Middle mountain – 6,9%

For mountain landscapes Korean pine forests are typical

Conclusion

The electronic layer “Landscape complexes” information basis for:

- ✓ The analyses of the environmental management in the Amur River basin
- ✓ For planning of the sustainable environmental management in the complex programs of absorption trans-boundary territories of Amur River basin.

The first step of the working on the program of sustainable development – functional zoning of the Amur River basin.

In future:

Landscape mapping of Chinese and Mongolian Parts of the Amur River basin, and analyses of the landscape changes under natural and anthropogenous factors.

Thank you!



Arctic Fox