Land Use/Cover Change: Global challenges – Local solutions

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Global challenges

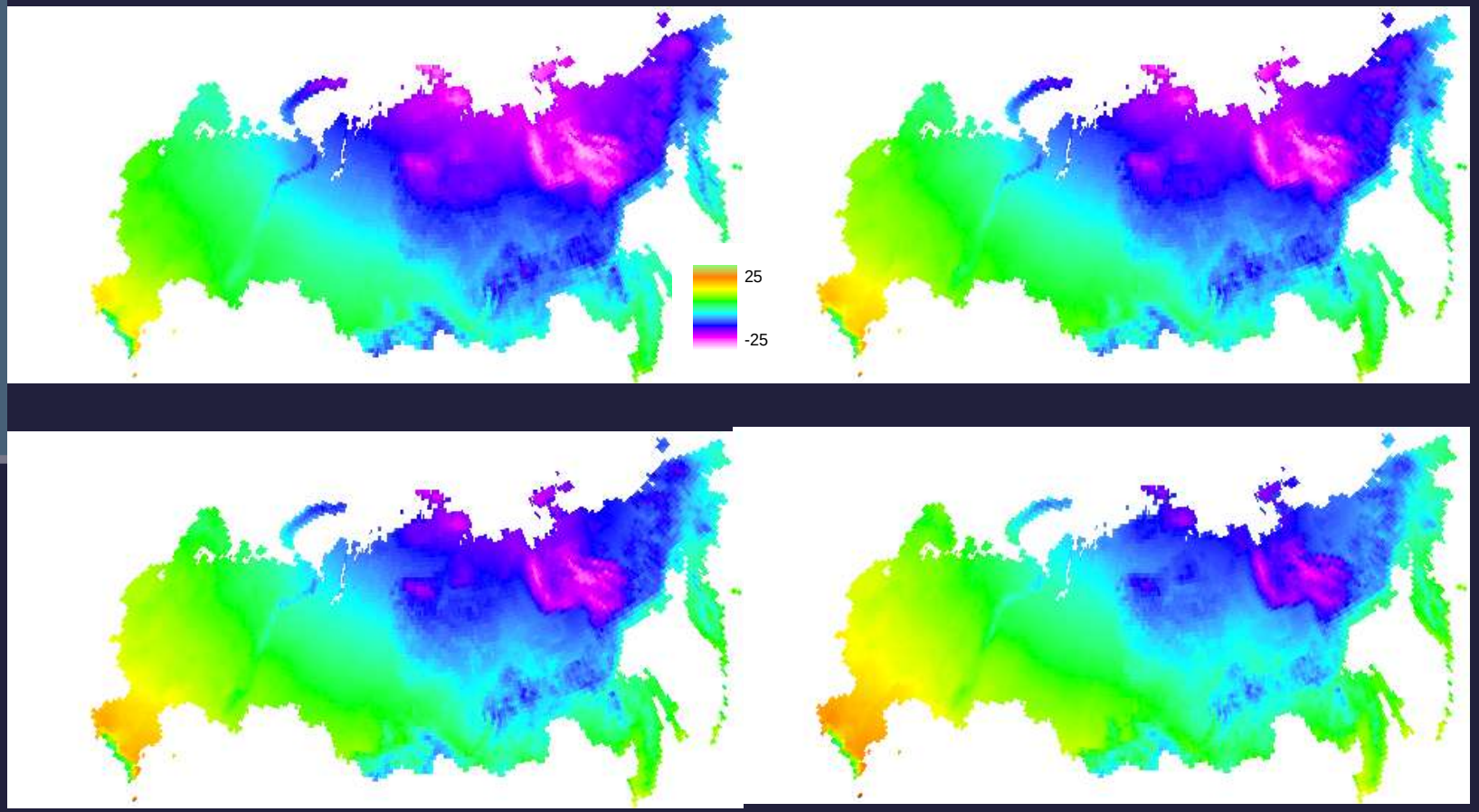
Climate change, Land and Biodiversity Degradation - very vital contemporary factors influenced LUCC

- Land use/cover change (LUCC) is a complex process, driven by both natural and anthropogenic factors
- Between the natural factors climate is one of the most important that shape the land cover and biodiversity

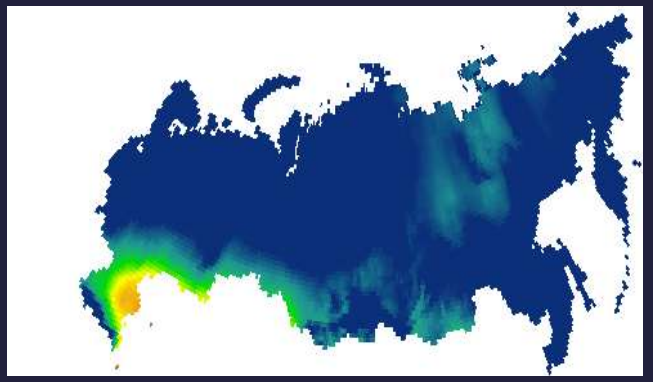
Climate change scenarios (from GCMs) show significant increase of temperature

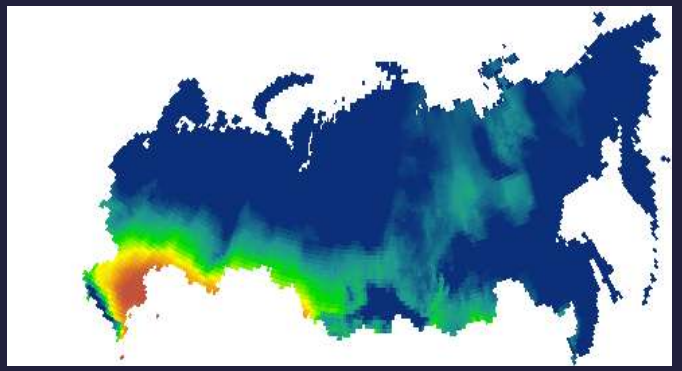
Figures: Current, 2020s, 2050s, and 2080s scenarios

In 2020s the annual temperature is estimated to increase by 1,6 - 1.8 °C for the entire Russia on average
In 2050s –by 3.1° - 3.4 °C
In 2080s –by 4.7 ° - 5.2 °C



Annual precipitation scenarios show the moderate increase of precipitation and of moisture deficit that will lead to decrease of water availability for agriculture and threaten the farming





Positive effect of climate change with more favorable conditions for agriculture

- More high annual temperatures will promote *increasing of the vegetation period length* (for 10-20 days by 2015) and reduce the risks connected with spring and winter frosts because of decreasing the repetition of soil freezing t^0

- It is expected *increasing of yields for fodder and cereals crops*, especially in south regions (20-30%). The boundary of maize and sunflower crops growing could go more to the north for 200-300 km (till the latitudes of Moscow and Middle Ural).

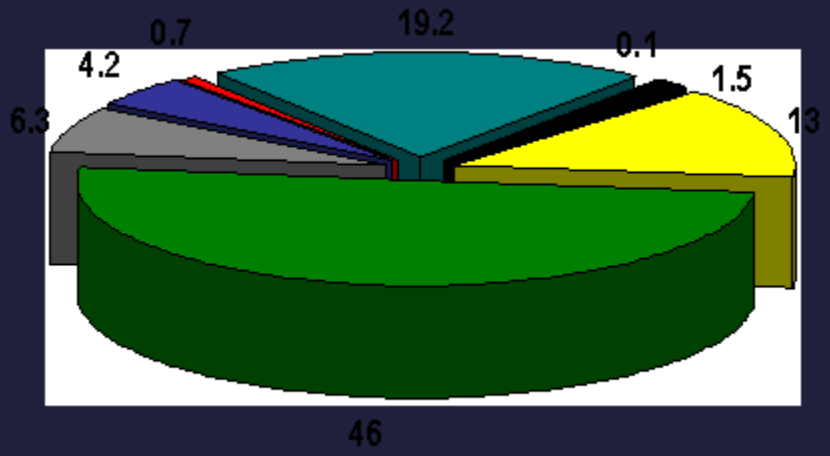
Negative effect

Increasing of temperature in combination with decreasing of moistening could lead to more high probability of summer droughts (1,5-2 times more by 2015)

Accordingly it is expected *yields decreasing* by 14- 22% and more frequent shortfalls (which are defined as the yield falling below 50% of the average), especially in main cereals' producing regions with fertile chernozem regions

Main driver of land cover and biodiversity change in Russia is agriculture.

Agricultural lands (yellow) occupy 13% of country area (1720,8 mln ha), including 40% of arable lands



- forest – 46%
- agricultural lands – 13%
- marshes – 6.3%
- water bodies – 4.2%
- reindeer pastures – 19.2%
- built-up lands – 0.7%
- disturbed lands – 0.1%
- others – 1.5%

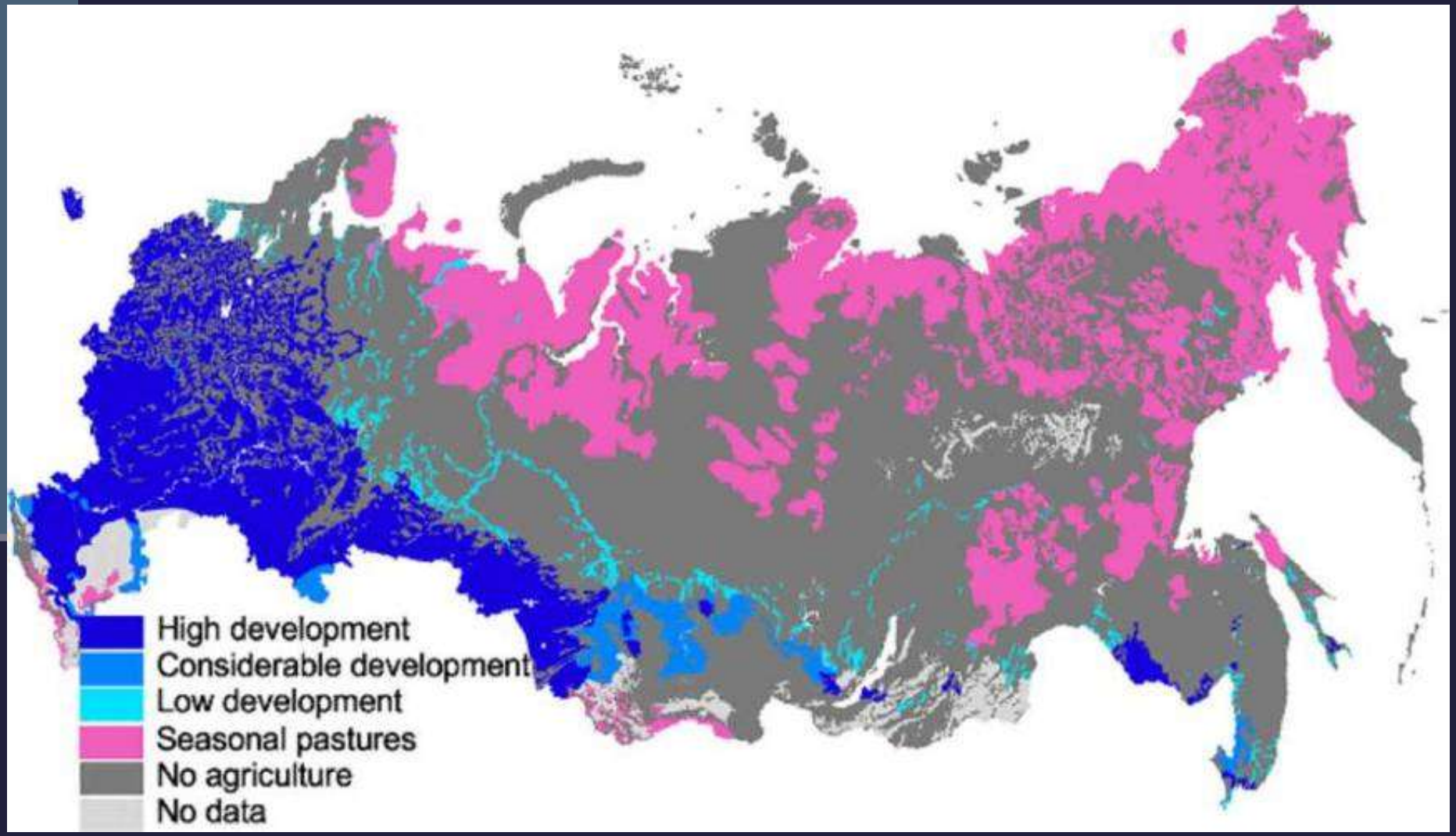
The structure of lands has significant geographical diversity: the most of country is located in the forest and tundra zones (considered as a high-risk for agriculture development -permafrost, insufficient vegetation period and high moistening)

Land use by natural zones

	Mln ha	%	Forested Areas	Agricultural Lands
Middle Taiga	222,8	13,0	76,4	-
Southern Taiga	245,4	14,3	57,6	17,3
Forest-steppe	127,7	7,5	27,5	57,2
Steppe	79,9	4,7	-	73,3
Dry Steppe	22,2	1,3	-	85,5

The territory with high development of agriculture in Russia is located in the wide (1,5 thou km) steppe zone to the south of 55° N latitude

It is the most important zone for food production (40% of country agricultural production is produced and about 30% of the rural population is concentrated here)



Agriculture conditions in Russia

Russia economy during long time was developed under the conditions of strong centralization, lack of the normal market and isolation from the most of the global system.

Agriculture restructuring in transition time have put severe strains on the agricultural production:

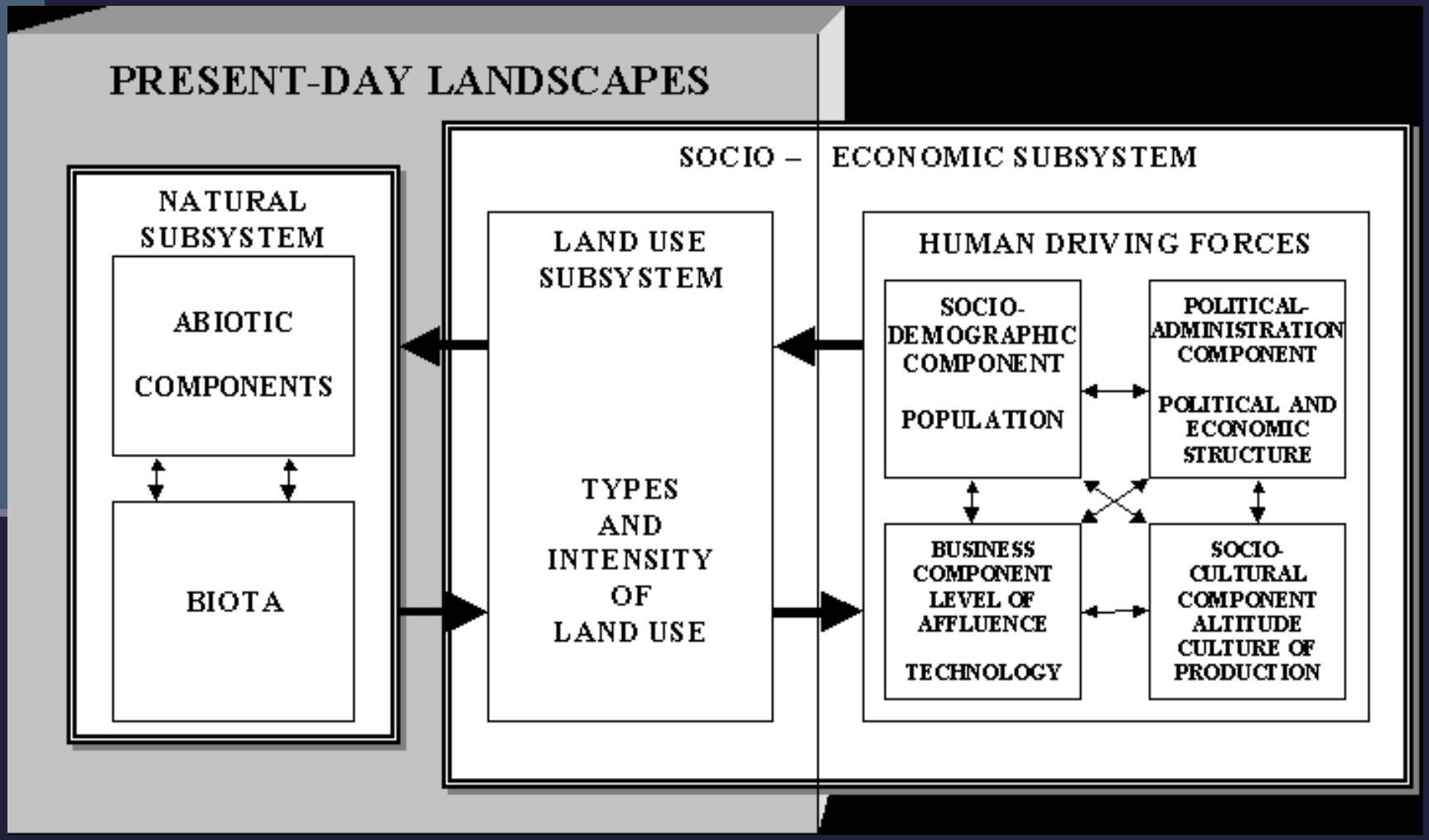
1. Changes in ownership and land specialization
2. Stagnation in agriculture

In 2001, Russia's new Land Code came into effect but it has limited applicability to agricultural lands. Then in 2002 Russian Federal Law ‘On Circulation of Agricultural Lands’ was adopted. Anyway new legal Conditions are not quite able to change drastically the situation with agriculture field ownership and management.

3. Relations between nature and society are still unfovarable:

- Still prevailing of the department(ministry)-based approach to land resource management;
- Economic value of land resources is still the main criteria of land use management without taking into account land cover and biodiversity changes.

To assess and map land use/cover change present-day landscape methodology was used, because it comprises various aspects of natural and socio-economic environment



Geographical scaling is the important issue for LUCC evaluation and mapping

Scaling of LUCC investigations define:

- **the degree of information details**
- **resolution of remote sensing data**
- **methodology of classification & mapping**

Different spatial levels of LUCC study in Russia were done at :

macroregional **- for the whole Russia,**

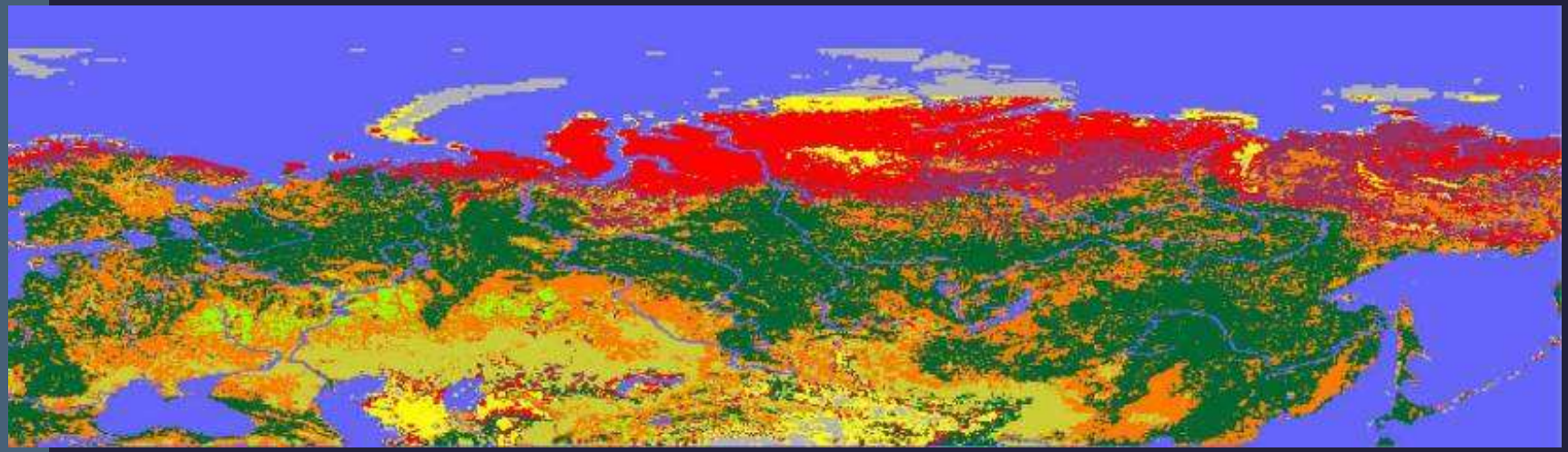
regional **– Central EPR, Siberia**

local large-scale **– case studies**

The land cover applications were done at macroregional, regional and local scales on the base of cartographic, remote in-field data

Macroregional Level of Land Cover Classification

Present-day landscapes were stratified on the base of 10-km resolution AVHRR images and NDVI data (not only floristic features). For steppe agrolandscapes it allowed to find some discrepancy with traditional maps (ex.- to differentiate areas of intensive irrigation in N.Caucasus from more dry steppe regions in Volga & West Siberia)

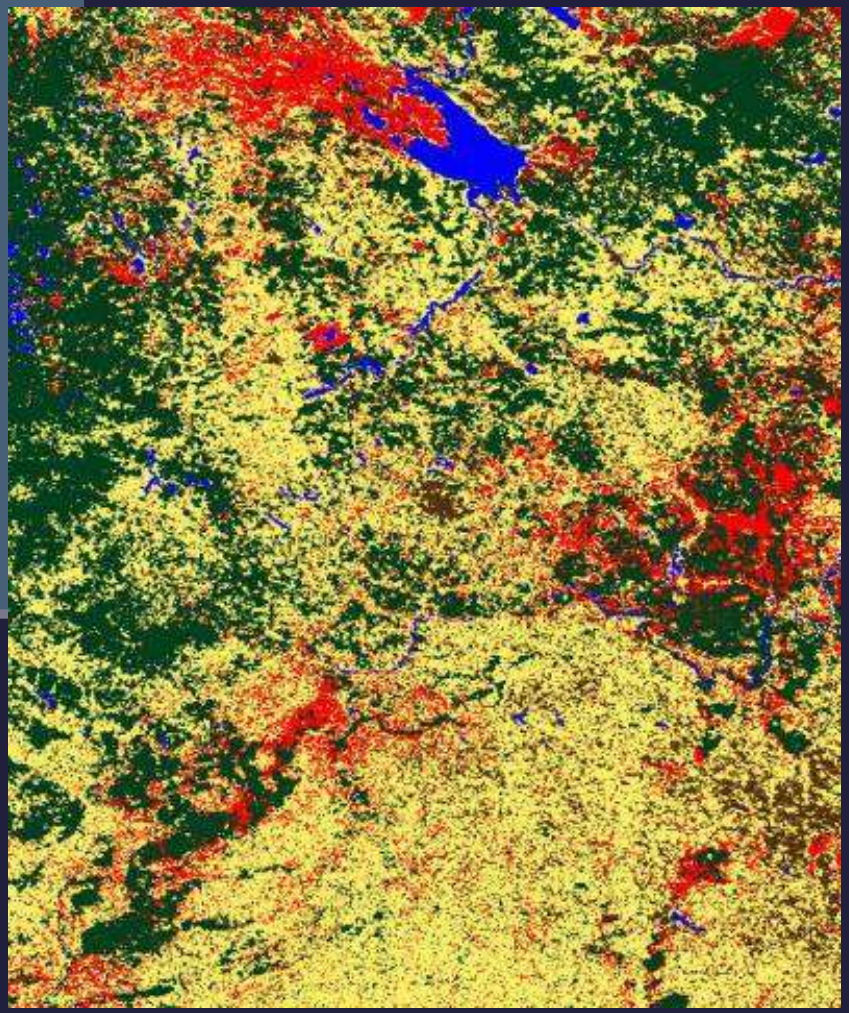


desert
shrubland
water
error data

forested shrubland
forest
forested grassland
grassland
not agreed

Regional level of Land Cover Classification

1-km seasonal vegetation activity (NDVI - phenological stages) data from AVHRR were used instead of different spectral zones for the same season that allowed to distinguish seasonal agrolandscapes dynamics, moistening and draining conditions



LEGEND

Wet poorly drained mostly coniferous forests and agricultural lands

Dry well drained secondary deciduous forests

Dry well drained agricultural lands

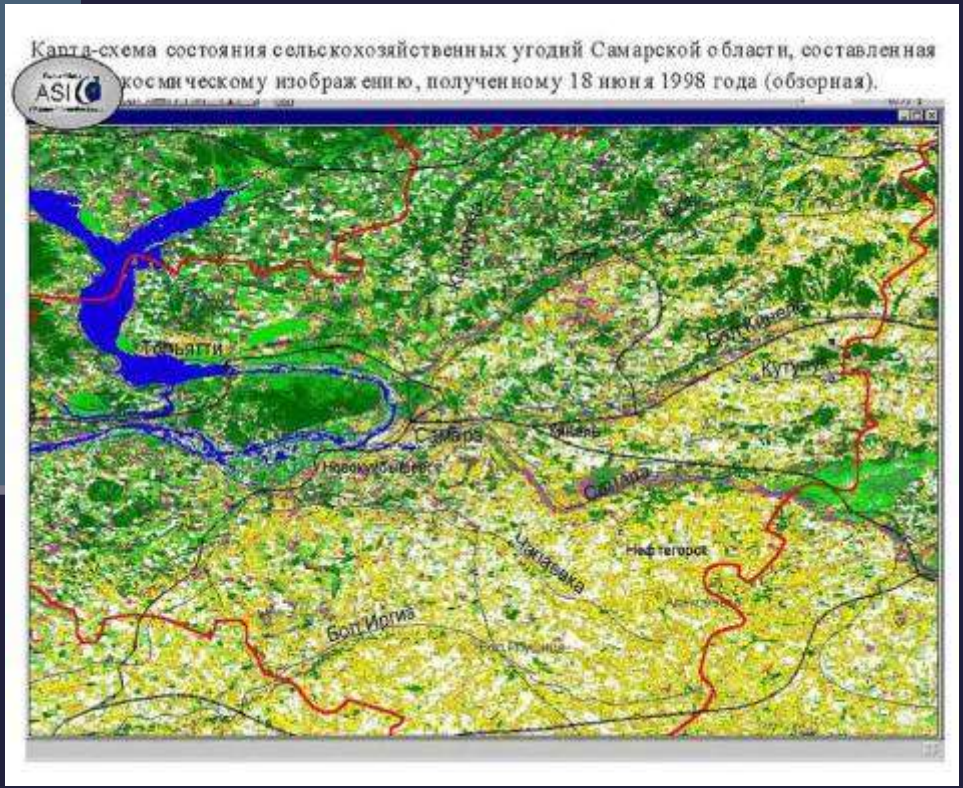
Low-vegetated urban and rural lands

Water bodies

Pattern of LUCC: urban development over agricultural lands; deforestation; recovery of forests; waterlogging of arable lands

Local case study was done in the Middle Volga region

The region is characterized by variability of climatic conditions and due to droughts – by considerable failures in crop yields, land degradation and decreasing of arable lands. Severe droughts occurred: in 1891 (mass starvation), in 1921 (effect was increased by political factors and came to millions of victims), in 1940-1946, the last in 1992 - 1998



The map was compiled on the base of remote data and shows influence of droughts on state of agricultural lands in Samara oblast :

green- crop cover of soil is more than 50 - 60% (satisfactory)
yellow - crop cover of soil is 20-50% (moderately suffered)
white- crop cover is less than 10 - 20% (strongly or catastrophically suffered)

Agriculture impact on land cover & biodiversity

During the last 25-30 years the steppe landscapes are degraded drastically and humus lost achieved in some regions 30% - 50%, that leads:

- to abandonment of arable lands or their transformation to grazing lands,
- decreasing of biodiversity of landscape and
- reducing of rural residents

Agricultural lands are important opportunity for biodiversity conservation

About 25% of steppes consist of semi-natural ecosystems –meadow pastures, hay fields, fallows and serve:
1) as shelter for biodiversity
2) as source of genetic material for agriculture
3) for recovery of abandoned farmlands due to: natural succession supported by the flow of seeds, resettlement of soil invertebrates

Local solutions to sustainable land use policy are directed to:

- development of ecologically sounds land use practices (green farming)
- widening of drought-resisting crops area
- usage of water-saving technologies
- rural ecotourism development
- education of people in land management
- elaboration of adaptive mechanisms to global changes

Conclusion

- Land Use/ Land Cover research have to address relationships of global challenges and local consequences/solutions, which have to coincide with each other

- Local solutions have to take into consideration local nature and economic conditions to elaborate sustainable land use policy