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Department for Physical Geography and Geoecology



Research in
Landscape Ecology

Principal methodological premise of the Research Group:

Different places are different with their processes and the process runs differently in different places. **To understand and manage the environment we should study the relations between environmental processes and spatial heterogeneity. Our research of various environmental issues is based on the concepts of Landscape Ecology.** It is rapidly developing interdisciplinary science that focuses on the ecological understanding of spatial heterogeneity. Landscape Ecology combines process/functional approach of Ecology with spatial approach of Geography to explore questions on the assessment, conservation, management, and planning of landscapes.

Key research topics of our Group in Landscape Ecology:

- **Stability of landscapes** and ecosystems to anthropogenic pressures and disturbances
- **Prognosis** of landscape change using Markov chain models
- **Spatial patterns** of landscape: mapping, modeling, typology
- **Niches of landscapes in** multidimensional space
- **Risk assessment** to landscapes and ecosystems
- Assessment of **ecosystem/landscape services**
- **Spatial flows** in landscape: mapping and modeling
- **Landscape diversity:** mapping and evaluation
- Planning of the **ecocorridors and econets**
- **Landscape remediation:** environmental assessment of waste deposits
- **Landscape perception** and landscape esthetic values assessment

How we do it:

**LANDSCAPE ECOLOGY :
CONCEPTS AND METHODS**

*Combined
with*

The GIS

Geographic Information Systems are used to identify, quantify, analyze landscape patterns, changes, transformations; *we prefer Open Source / Free GIS*

Are applied to particular region

REGION

Presenting the results with the various maps is our approach; *Mapping is our language*

Most research are done at regional scale, for various regions of Ukraine *Regional, not local, approach to landscape and environmental problems* is a landmark of our Research Group

IMPLEMENTATION INTO THE PRACTICE

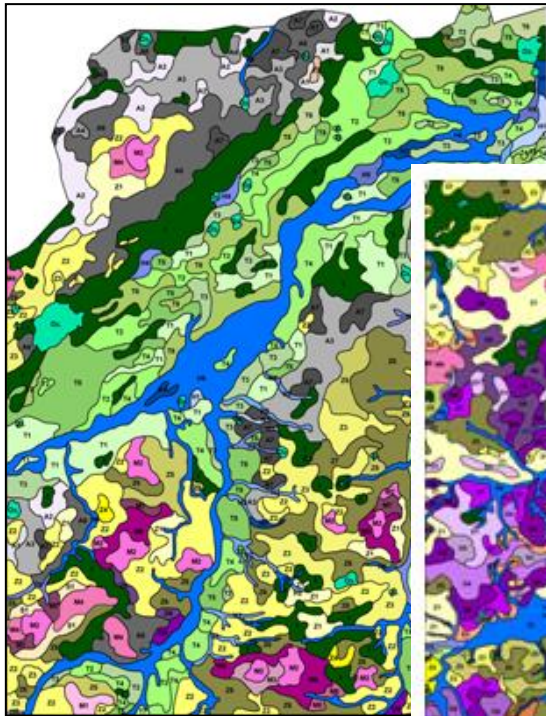
Most projects of the Research Group are practically oriented; We do not just apply known methods, but develop *new innovative methods and tools being efficient for solving practical issues*

- → *Planning of the econets*
- → *Risk assessment*
- → *Prognosis of the landscape transformations*
- → *Prediction of the polluted areas*
- → *Landscape diversity and Nature protected areas*
- → *Waste utilization*
- → *and other ...*

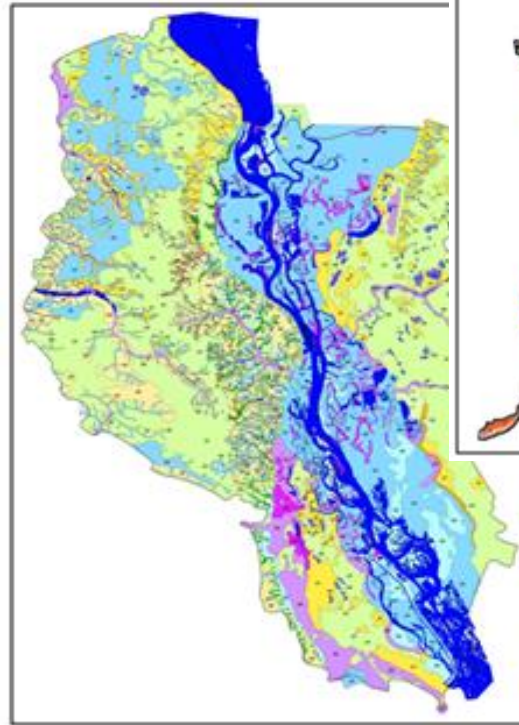
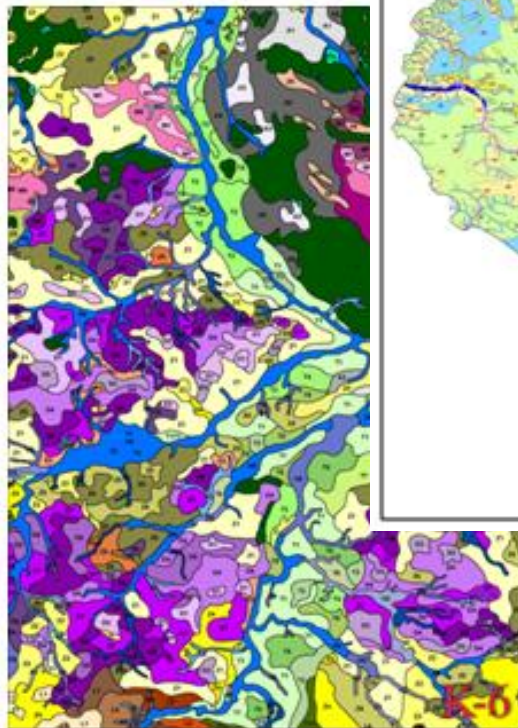
Some examples: **LANDSCAPE MAPPING AS THE BASIS FOR APPLIED ENVIRONMENTAL RESEARCH**

The landscape maps describe and visualize the spatial heterogeneity and spatial patterns of the area. **Composing landscape map is the starting point of most of our research.**

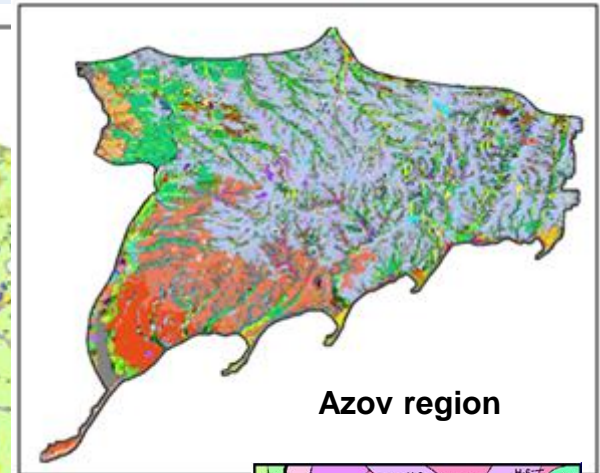
The landscape mapping is based on the concept of landscape polistructurality (a landscape has not a single one but many spatial structures). Original methodology for identifying landscape structures and their mapping was developed.



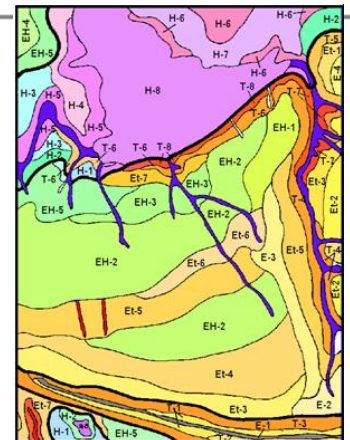
Volyn region



City of Kiev

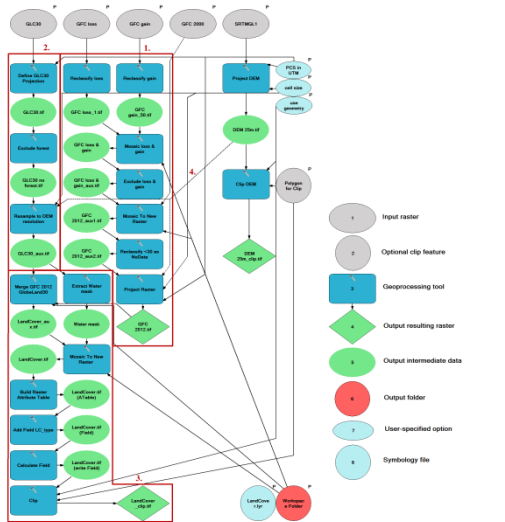


Azov region

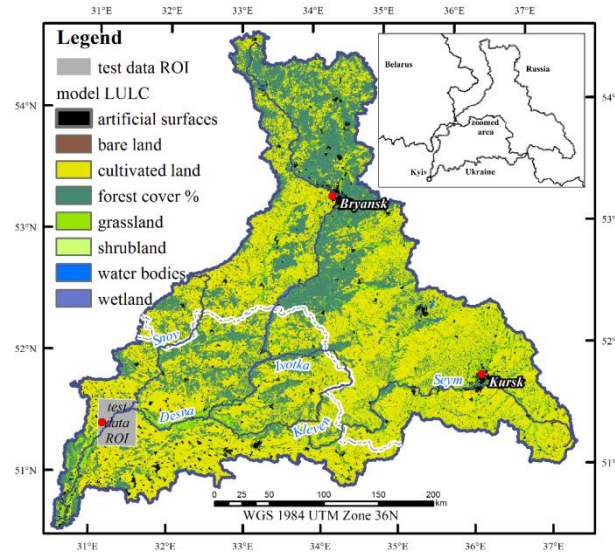


Northern Crimea

Some examples: THE LANDSCAPE CURRENT STATE (LANDCOVER TYPES) AND THE EXTENT OF LANDSCAPE ANTHROPIZATION

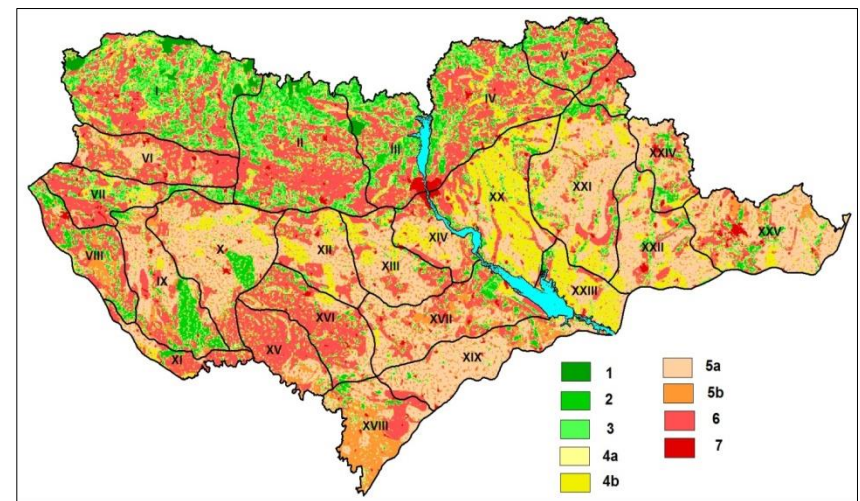
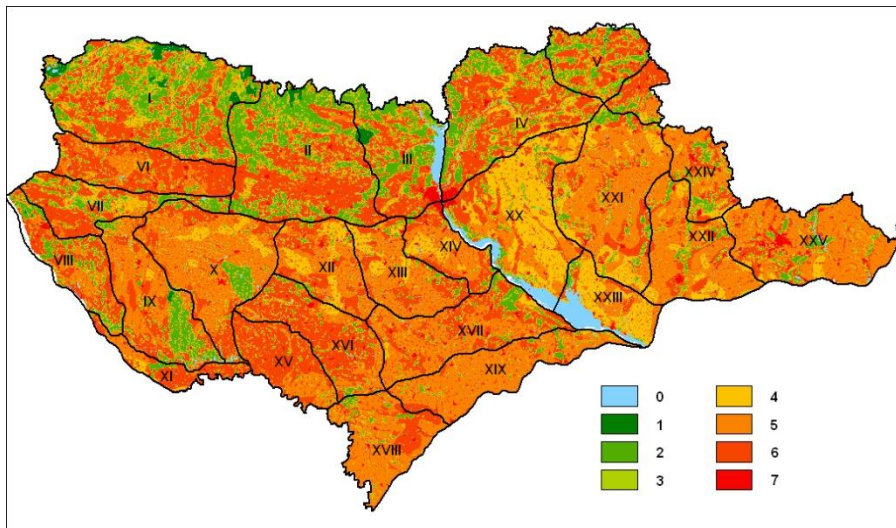


GlobeLand30 LULC and Global Forest Change 25 m geodata merging workflow



Actual landcover of the Desna river's basin

Original methodology for identification, assessment, and mapping of the current state of landscape units (landcover types) and the extent (degree) of landscape anthropization are used. *The maps and evaluations are needed to see where we are now with the landscapes and ecosystems*



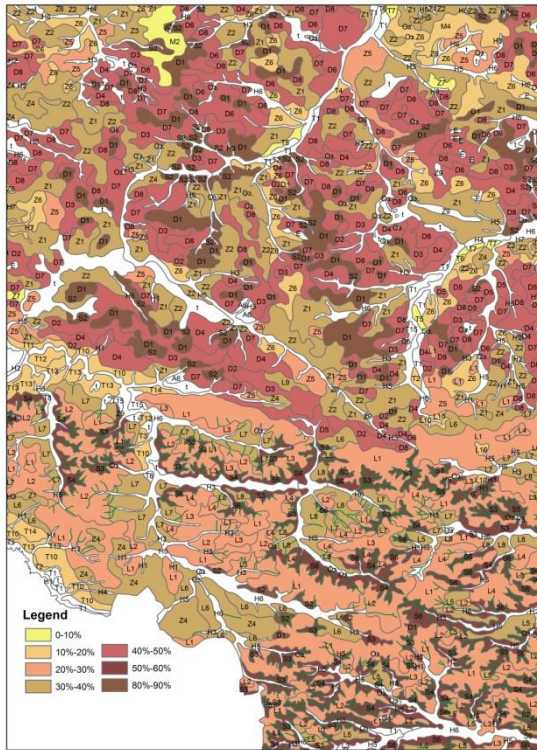
Some examples: THE ASSESSMENT OF RISKS TO LANDSCAPE AND THEIR SERVICES

Risk is the function of two components:

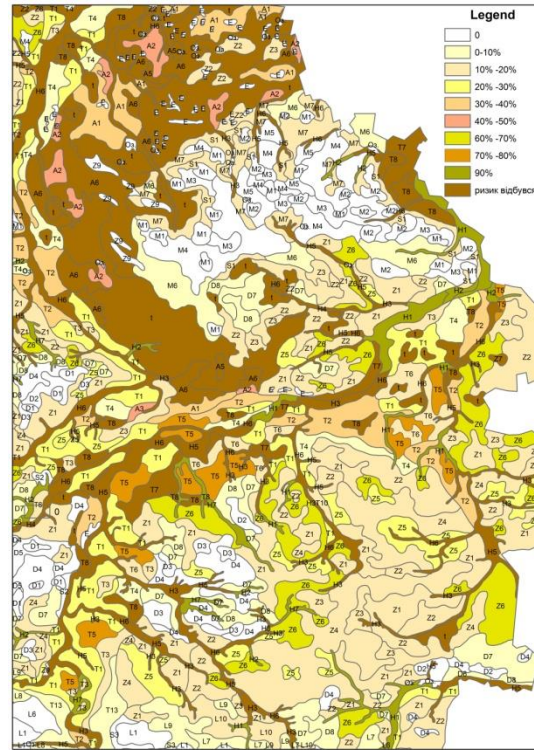
- 1 – the probability of undesirable landscape chsmnges (evaluated with the models of reliability theory)
- 2 – the harmful effect of this transformation (estimated with thje use of Harrington’s desirability function)

$$p(\Delta t) = \sum \exp\{-\lambda \Delta t\} \frac{(\lambda \Delta t)^k}{k!} (F_{(x.kp)})^k, \quad D = \sum_{i=1}^n a_i \sqrt{\prod_{i=1}^n d_i^{a_i}} \quad d_x = 1 - \exp\left\{-\exp\left\{-\left[9 \frac{x_{opt} - x_{risk}}{x_{cr} - x_{risk}}\right]^{1,927} - 2\right\}\right\}$$

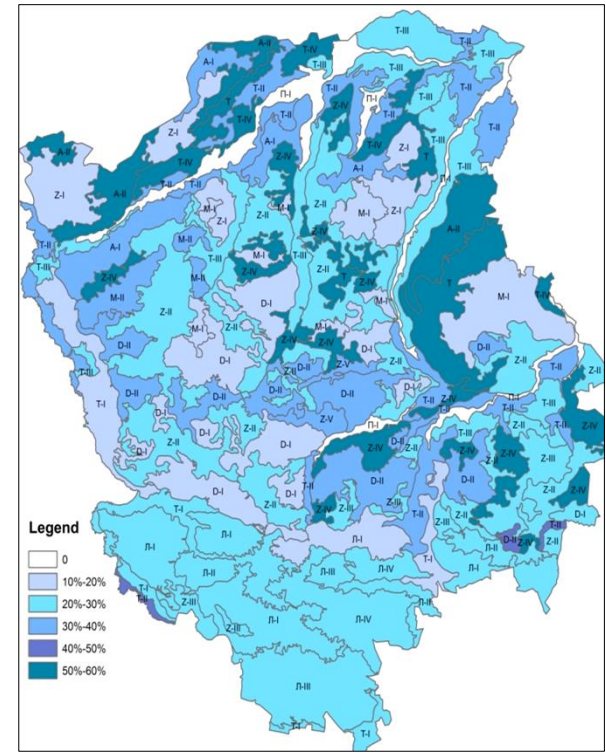
Examples of maps of risk assessment for Volyn region, Ukraine



Risk of LS-3 type – surface stability

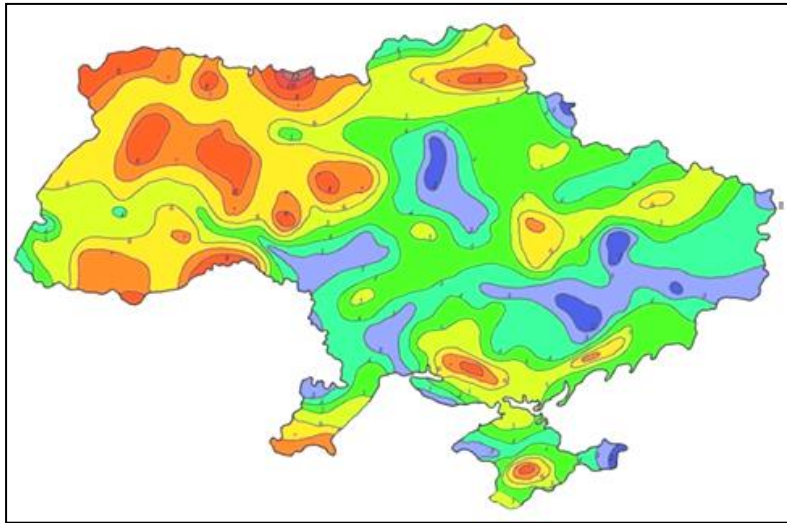


Risk of W-6 type – water logging

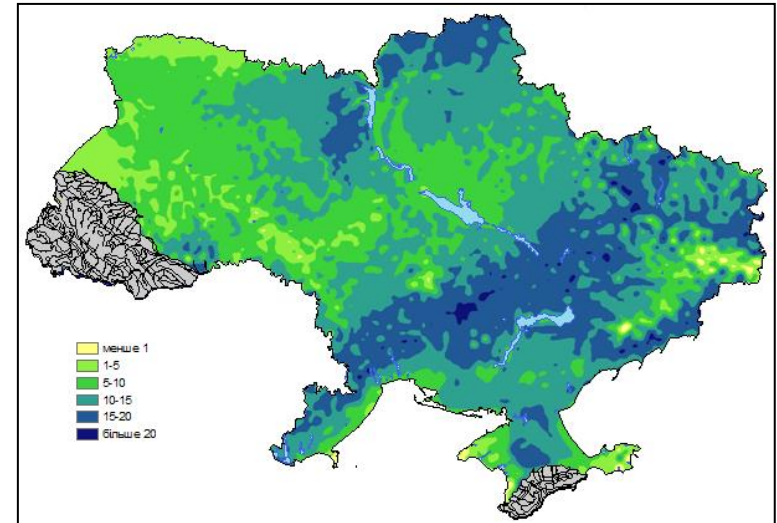


Risk of DS-2 type – wind erosion

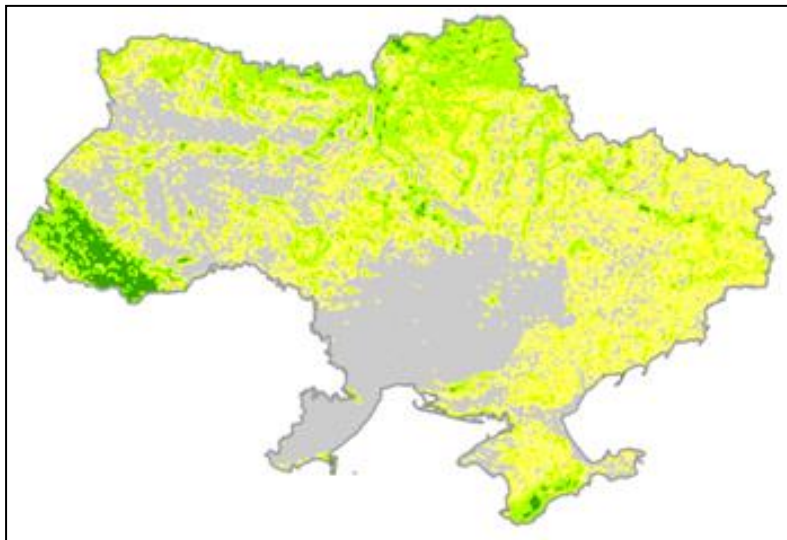
Some examples: **LANDSCAPE DIVERSITY: MAPPING AND EVALUATION**



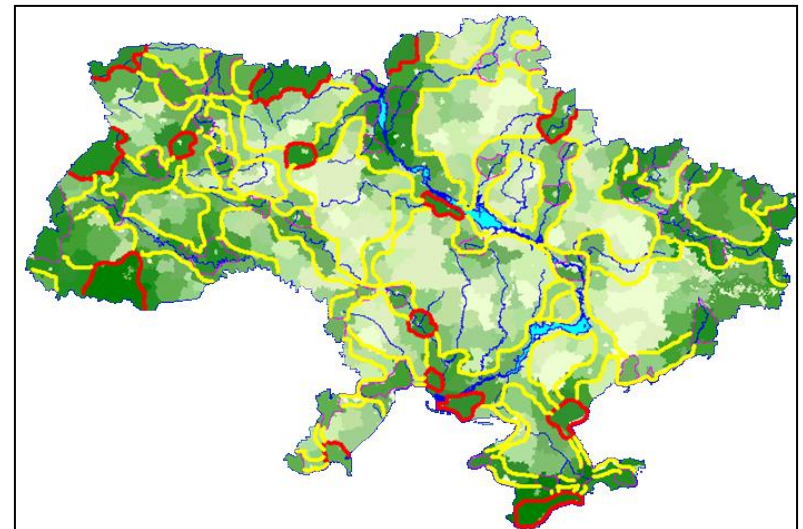
Topological landscape diversity



Climatic factor of landscape diversity

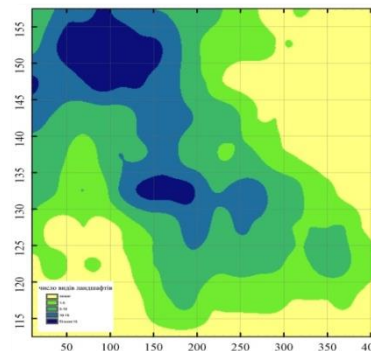
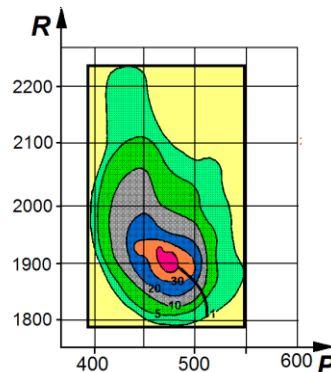
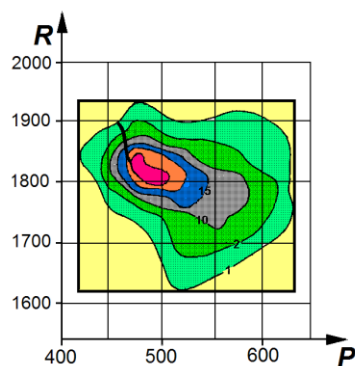
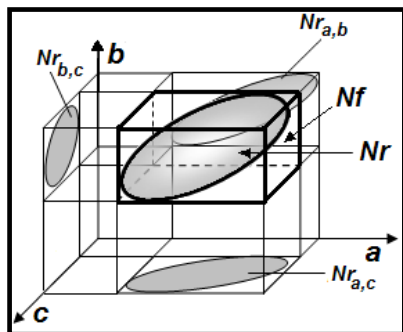


Landscape fragmentation



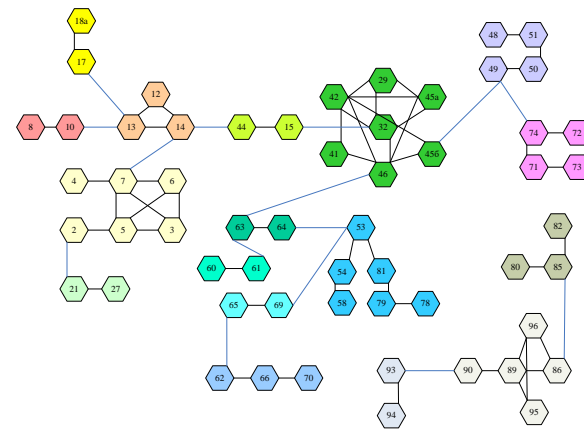
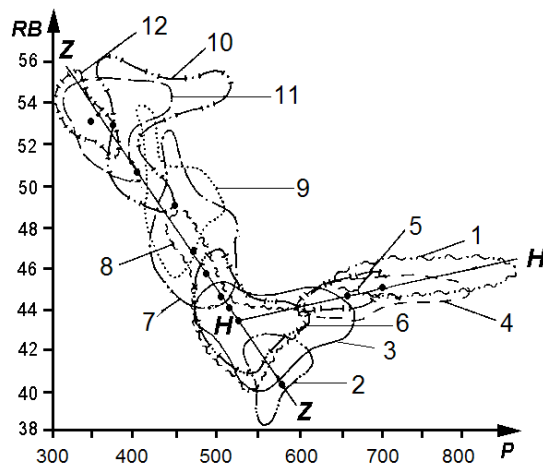
Biotic Gamma-diversity of landscape and scheme of regional core bio-landscape areas and ecocorridors

Some examples: CONCEPT OF LANDSCAPE NICHE AND ITS APPLICATION FOR NATURE CONSERVATION



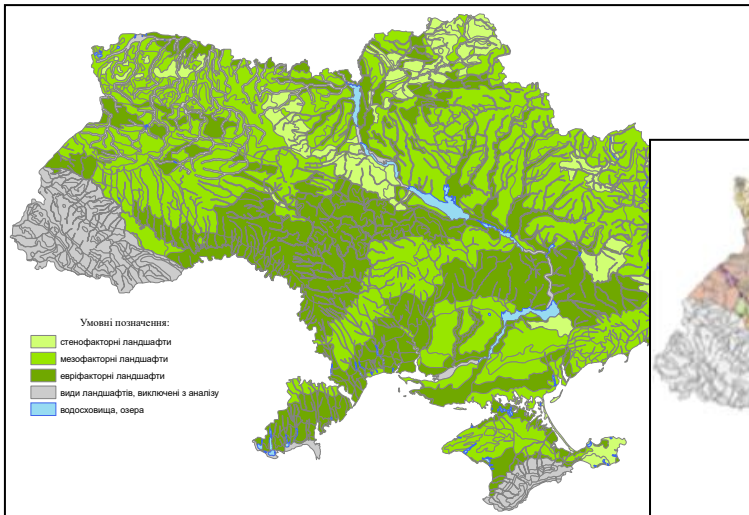
The concept of niche from ecology (in Hutchinson's version) was adopted to landscapes; methods for identification of niches, evaluation of their parameters (width, shape, zones of overlapping etc) were proposed and used for solving few practical problems (new nature protection areas, planning of the econets, prognosis of landscape change as their reaction to global and regional climate change)

$$\tilde{\rho}_{ij} = \frac{\int \varphi_i(x) \varphi_j(x) dx}{N^i \cap N^j} \cdot \frac{1}{\left(\int [\varphi_i(x)]^2 dx \int [\varphi_j(x)]^2 dx \right)^{1/2}}$$

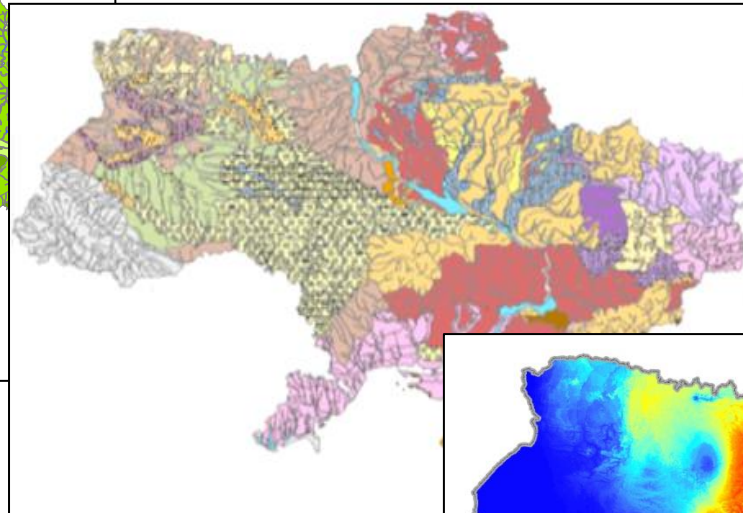


Some examples: **CONCEPT OF LANDSCAPE NICHE** **AND ITS APPLICATION FOR NATURE CONSERVATION**

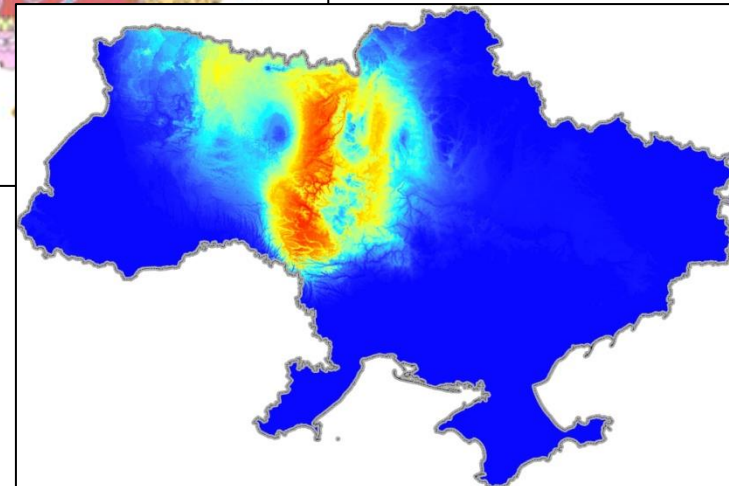
From the theory to the collection of maps



Fragile landscapes (degree of fragility)



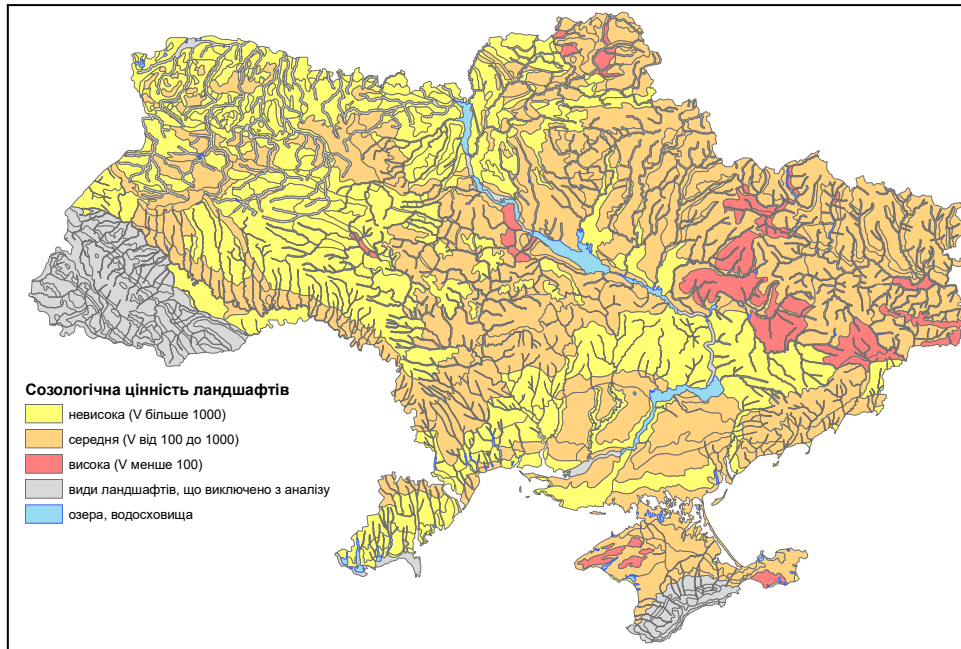
**Critical factors for
landscape instability**



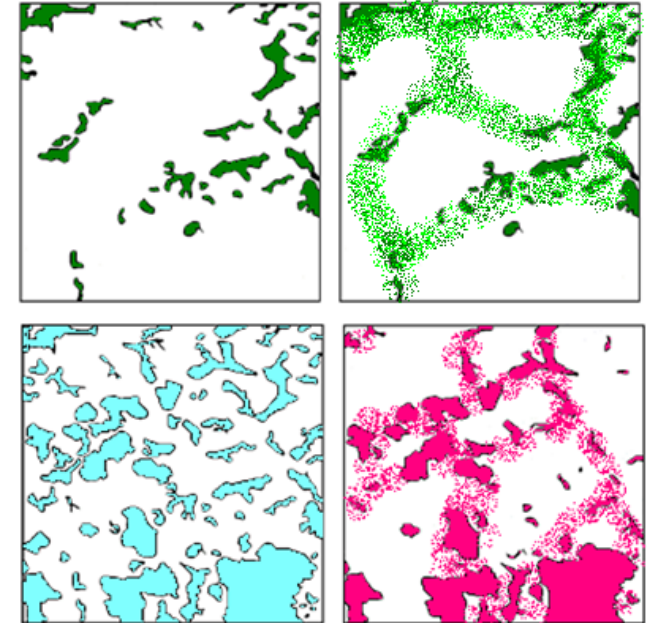
Possible spatial niche for landscape type 45

Some examples: **CONCEPT OF LANDSCAPE NICHE AND ITS APPLICATION FOR NATURE CONSERVATION**

From maps to practical proposals

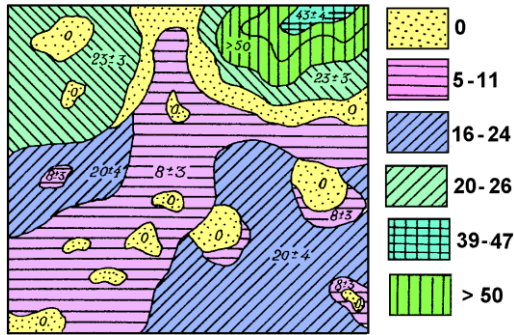


Priority regions for establishing of new nature protection areas and zones of landscape renaturalization

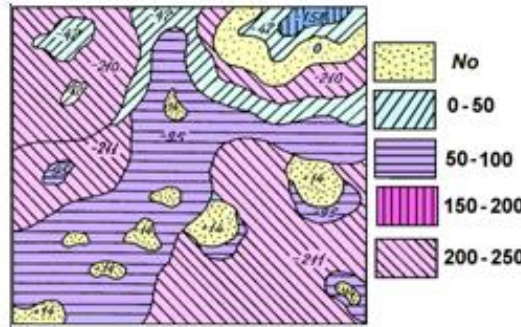


Habitats and routs of particular species migration to be protected, Trostyanec region, East Ukraine

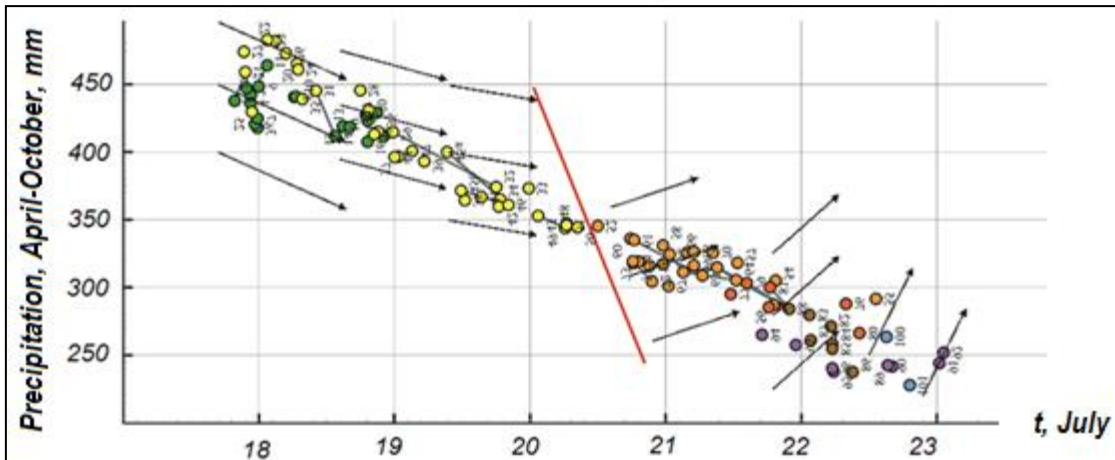
Some examples: PROGNOSIS OF LANDSCAPE CHANGE USING THE MARKOV CHAIN MODELS



Prognosis of the terms for critical soil salinization, years

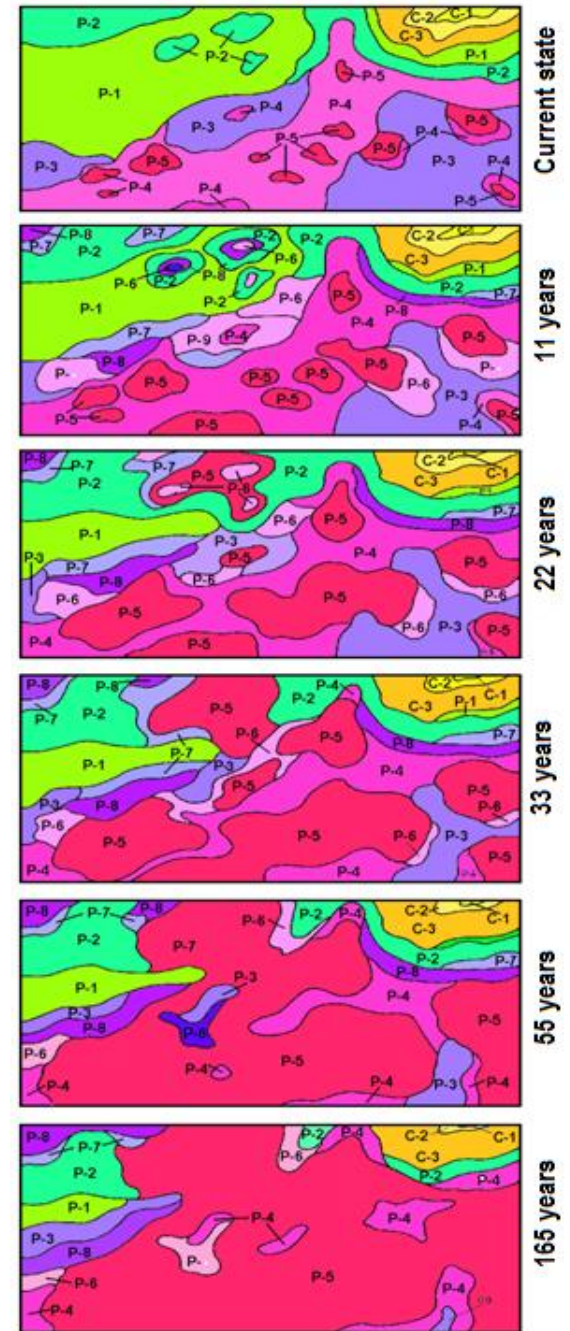


Prognosis of financial losses due to landscape transformations, UA Hryvna per ha per year

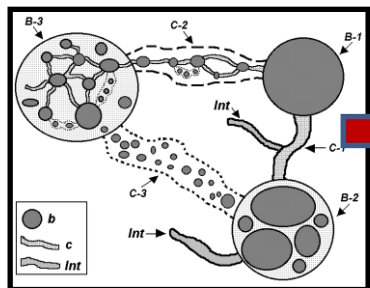


Predicted landscape succession under the climate change in Eastern Europe

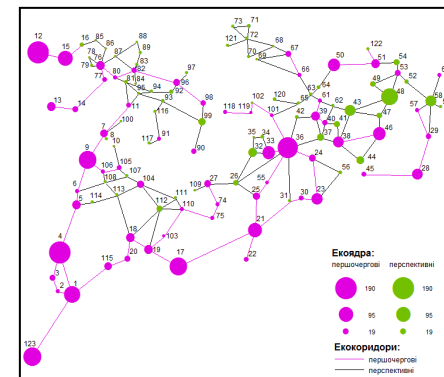
Prognosis of landscape pattern transformations



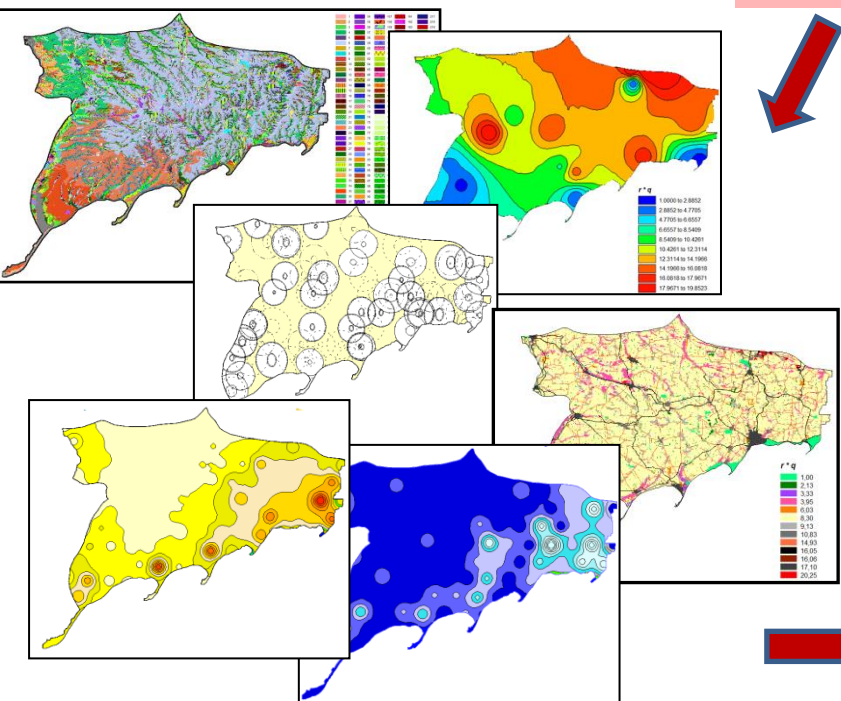
Some examples: **PLANNING OF THE ECONETS**



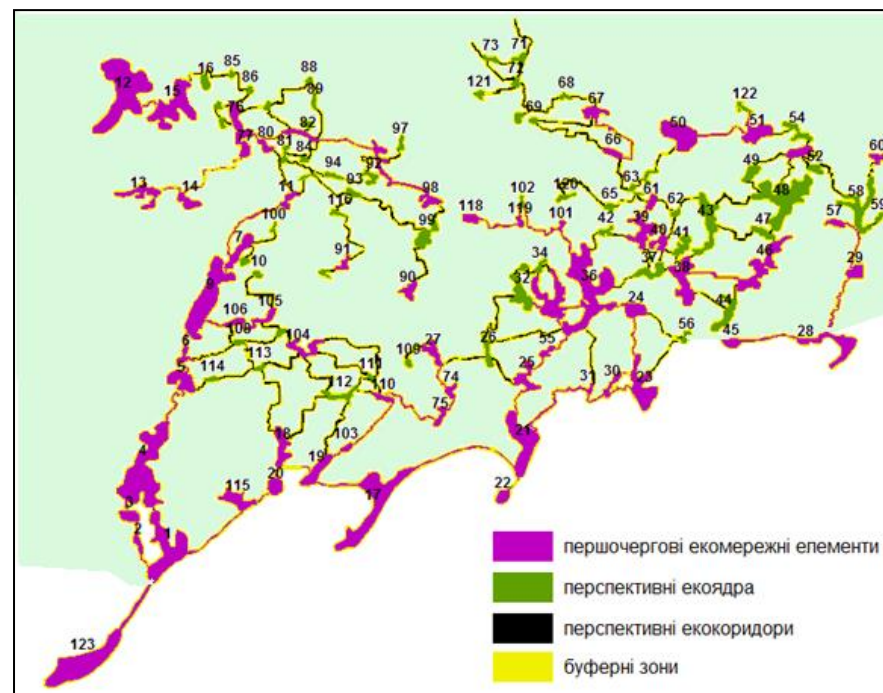
$$\{MC-6\} \in \{ \{EMЯ_{МКП}(\omega_{EMЯ} R_{EMЯ}) \cup EMKP_{МКП}(\omega_{EMKP} R_{EMKP}) \} \cap (U) \cap (U) (EMЯ_{МАПА}(\omega_{EMЯ} R_{EMЯ}) \cup EMKP_{МАПА}(\omega_{EMKP} R_{EMKP}) \} \cap (U) (PФПС((\omega_{PФПС}, R_{PФПС}) - ПОС(\omega_{ПОС} R_{ПОС}))) \} = \\ = \{MC-3\} \cap (U) \{MC-5\} \cap \{MC-4\} \equiv \\ \equiv \{EMЯ_{ОСТ.О.П}(\omega_{EMЯОСТ.О.П} R_{EMЯОСТ.О.П}) \cup \\ \cup EMKP_{ОСТ.О.П}(\omega_{EMKPОСТ.О.П} R_{EMKPОСТ.О.П}) \} ;$$



Modeling is used



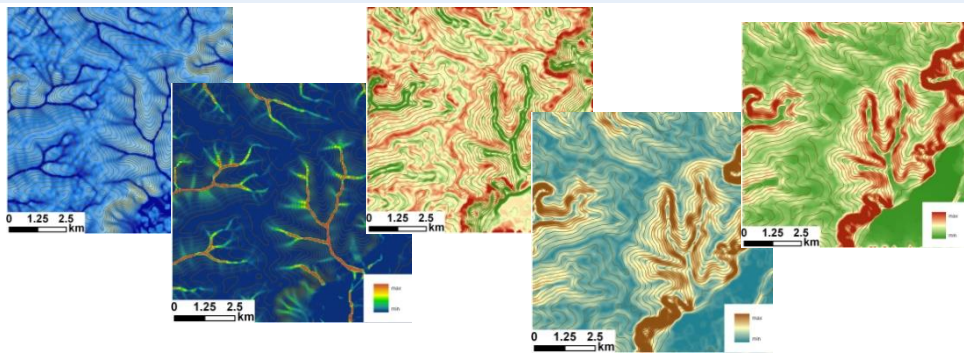
Series of maps is produced



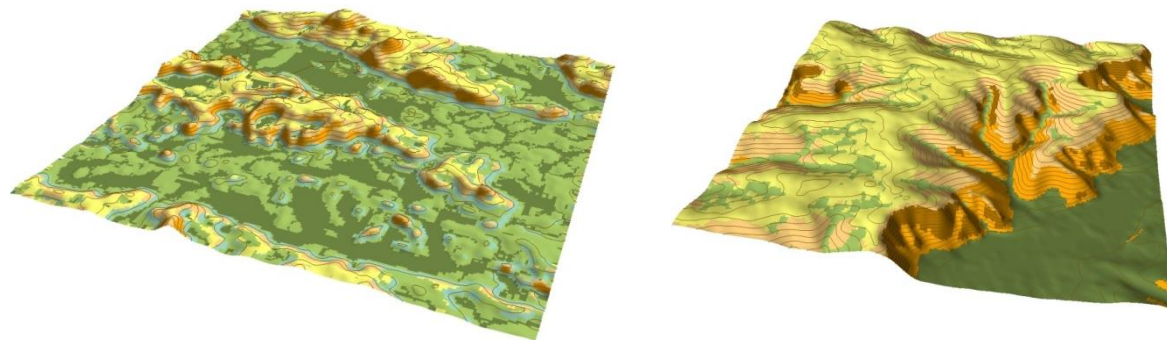
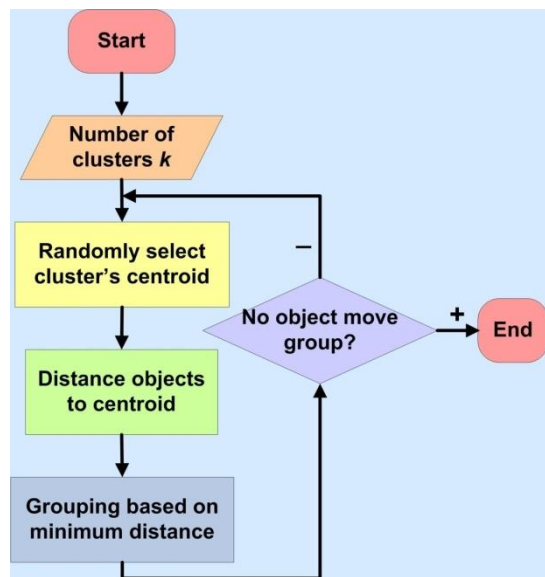
Project of the regional econet for Azov region

Some examples: MAPPING OF LANDSCAPE SPATIAL DYNAMICS PATTERNS BY THE FUZZY CLUSTERING ANALYSIS

Landscape spatial dynamics is largely controlled by lateral abiotic flows. Analysis of the DEM using the GIS is an appropriate basis for automated mapping of abiotic flows spatial pattern configuration, and identification of areas with high risk of secondary contamination in particular.

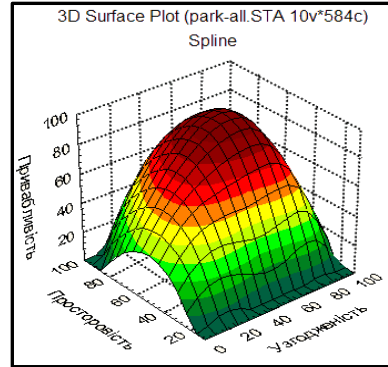
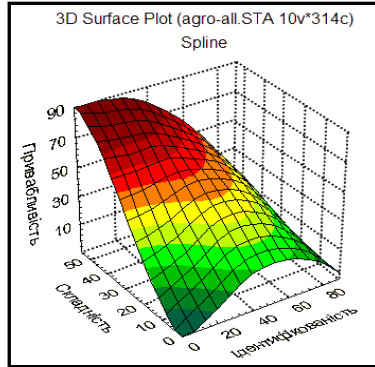
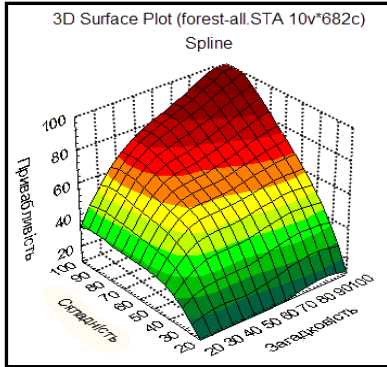


Open desktop GIS SAGA v. 2.0.7 DEM preprocessing and analysis and FuzME v. 3.5b software package fuzzy unsupervised data classification were used.

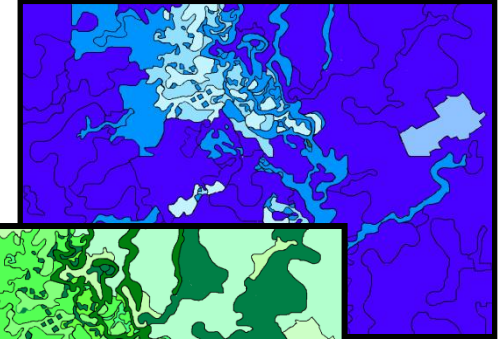


1	El-accum	Trans-el	Trans	T-accum	Hydrom	T-hydrom
2	Eluvial	Trans-el	Trans	Trans	T-hydrom	T-hydrom
3	Eluvial	Trans-el	Trans	Trans	T-hydrom	T-hydrom
4	Eluvial	Trans-el	Trans	T-accum	T-hydrom	Accum

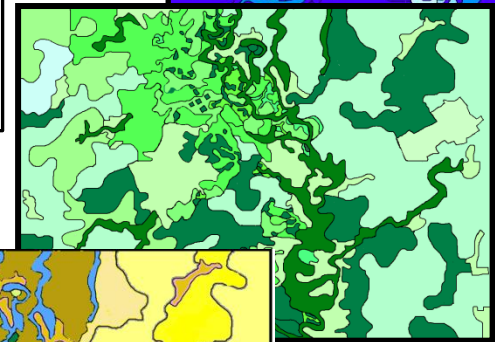
Some examples: LANDSCAPE PLANNING ON THE GROUND OF PEOPLES PERCEPTION OF THE LANDSCAPE AND LANDSCAPE PREFERENCES



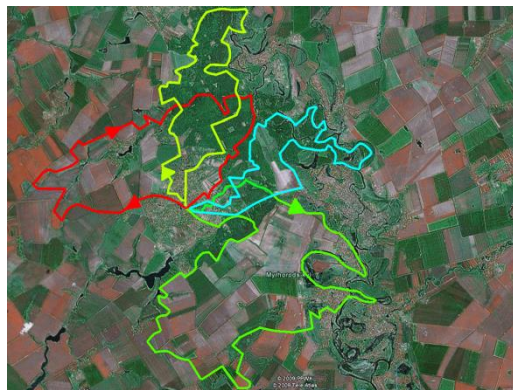
Landscape preference as a function of perceptual values of landscape



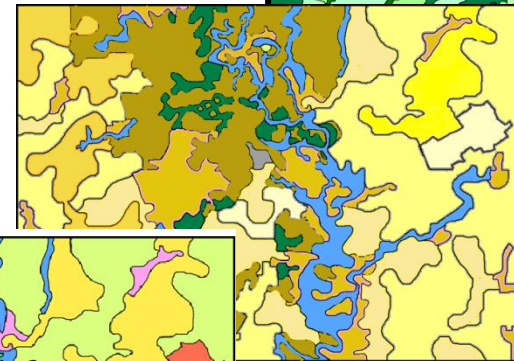
Landscape spaciousness



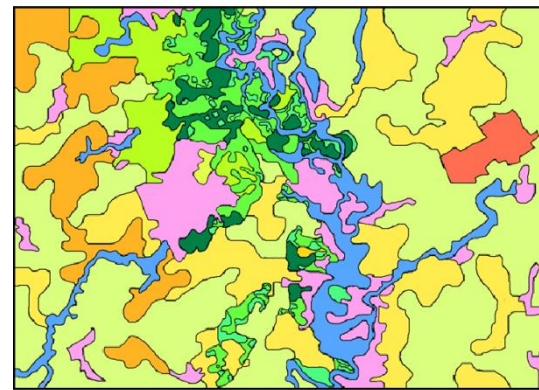
Landscape diversity



Touristic routes across the area



Landscape preference



Landscape functional zoning for recreation and leisure

PUBLICATIONS

Members of the Landscape Ecology Research Group of the Dept for Physical Geography and Geoecology have over 1000 publications, with about 50 books among them



Monographs of the Research Group leader Prof. M.Grodzynskiy

We are open to co-operate:
for your and our benefits,
for science and progress,
for sustainability and resilience,
for human wellbeing,
for clean environment



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