Land Use/Land Cover changes in the East and Central Europe - main trends and driving forces

Gregory N. Taff, *Premysl Stych, Jan Feranec, Tomas Soukup…and SCERIN group*

Aims

- *Describe the main trends (flow) of LCLU changes in the SCERIN area (spatial distribution and intensity in time) in Central and Eastern Europe after 1990*
- *Comparison of the change intensity 1990-2000-2006-2012*
  - *We'll discuss which time periods are achievable*
- *Presentation of methodology of mapping/analyzing landscape changes on a macro-scale based on Corine LC data*
- *Describe the main driving forces*
- *Experts explain the changes within each participating country*
- *Summarize regional trends in driving forces among participating countries*

Overview of land use and land cover changes in Central and Eastern Europe

- *LC changes in Central and Eastern Europe for 17 countries:*

Albania (AL), Bosnia/Herzegovina (BA), Bulgaria (BG), Croatia (HR), Czech Republic (CZ), Estonia (EE), Hungary (HU), Kosovo (KV), Latvia (LV), Lithuania (LT), Macedonia FYR (MK), Monte Negro (ME), Poland (PL), Romania (RO), Serbia (RS), Slovakia (SK) and Slovenia (SI).

- *periods: 1990-2000-2006 and 2012*

- *analyzed changes based on the Corine CLC database.*

Backround

- *Since the process of economic transformation has started in the beginning of the 90s in the Central and Eastern Europe, the important changes in land use and land cover have been starting.*

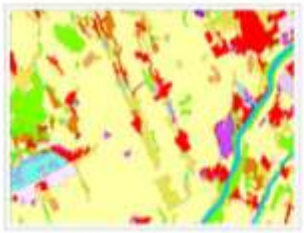
- *Before the 90 s, the LCLUC were influenced by of many factors typical for the socialism system:*
  - *land market, private property and market economy didn't exist actually*
  - *effort to reduce the regional differences was very high*
  - *financial sources were distributed by central rules for settlement structure*
  - *the law for land preservation was very strict in many countries.*

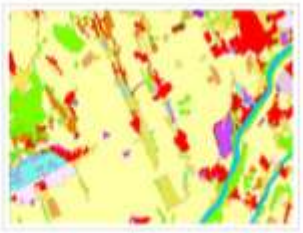
Backround

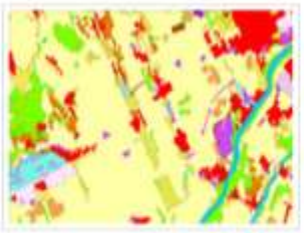
- *However after 1990 with the re-installation of a market economy, private property and land market, LCLUC have been influenced by many factors, e.g.:*
- *Collapse of the traditional limited trade – Comecon (The Council for Mutual Economic Assistance)*
- *Development of economy/transition/privatisation – polarization of core x peripheries (investments, settlements…)*
- *CAP, EU cohesion/development programmes*
- *(Pre)accession to EU/ global trade*
- *Land property, land privatization*

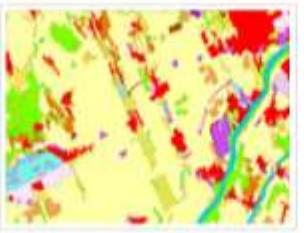
Data sources of the evaluation

- Corine land cover (CLC) 1990, 2000 and 2006


CLC 1990


CLC 2000


CLC 2006


CLC 2012


LCC 1990-2000


LCC 2000-2006

LCC 2006-2012

- It consists of an inventory of land cover in 44 classes
- Minimum Mapping Unit (MMU) of 25 ha for areal phenomena and a minimum width of 100 m for linear phenomena.
- changes in land cover with an MMU of 5 ha.

Corine land cover (CLC)

1 Artificial surfaces
11 Urban fabric
111 Continuous urban fabric
112 Discontinuous urban fabric
12 Industrial, commercial and transport units
121 Industrial or commercial units
122 Road and rail networks and associated land
123 Port areas
124 Airports
13 Mine, dump and constructions sites
131 Mineral extraction sites
132 Dump sites
133 Construction sites
14 Artificial, non-agricultural vegetated areas
141 Green urban areas
142 Sport and leisure facilities

2 Agricultural areas
21 Arable land
211 Non-irrigated arable land
212 Permanently irrigated land
213 Rice fields
22 Permanent crops
221 Vineyards
222 Fruit trees and berry plantations
223 Olive groves
23 Pastures
231 Pastures
24 Heterogeneous agricultural areas
241 Annual crops associated with permanent crops
242 Complex cultivation patterns
243 Land principally occupied by agriculture, with significant areas of natural vegetation
244 Agro-forestry areas

3 3 Forest and semi-natural areas
31 Forests
311 Broad-leaved forests
312 Coniferous forests
313 Mixed forests
32 Scrub and/or herbaceous vegetation associations
321 Natural grasslands
322 Moors and heathland
323 Sclerophyllous vegetation
324 Transitional woodland-scrub
33 Open spaces with little or no vegetation
331 Beaches, dunes, sands
332 Bare rocks
333 Sparsely vegetated areas
334 Burnt areas
335 Glaciers and perpetual snow

4 Wetlands
41 Inland wetlands
411 Inland marshes
412 Peat bogs
42 Maritime wetlands
421 Salt marshes
422 Salines
423 Intertidal flats

5 Water bodies
51 Inland waters
511 Water courses
512 Water bodies
52 Marine waters
521 Coastal lagoons
522 Estuaries
523 Sea and ocean

Overview of land use and land cover changes in Central and Eastern Europe

Main landscape changes for the second level of CLC classes

The "matrix of changes", groups LC changes of the same type, changes between the 15 CLC classes at the second level (Feranec at al. 2010).

1 – urbanization (industrialisation), 2 – intensification of agriculture, 3 – extensification of agriculture, 4 – afforestation, 5 – deforestation, 6 – water bodies construction and management, 7 – other changes (recultivation, dump sites, unclassified changes, etc.).

Overview of land use and land cover changes in Central and Eastern Europe

The size of the changed areas is too small to present on a map that shows all of Central and Eastern Europe (e.g., the smallest identified change area in the frame of the CLC mapping is 5 ha.).

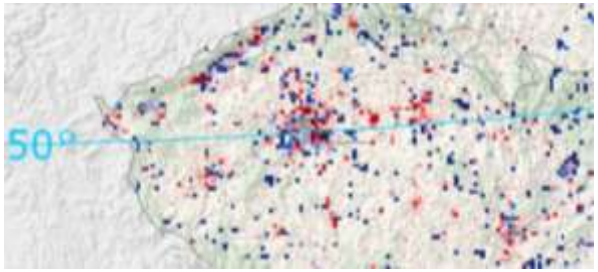
The presentation of their intensity/rate through a regular grid pattern.

Following the study by Feranec et al. (2010), we used a 3 × 3 km grid as a compromise between the actual spatial distribution of the seven above-mentioned changes and their presentation on the Central European level at a meaningful scale.

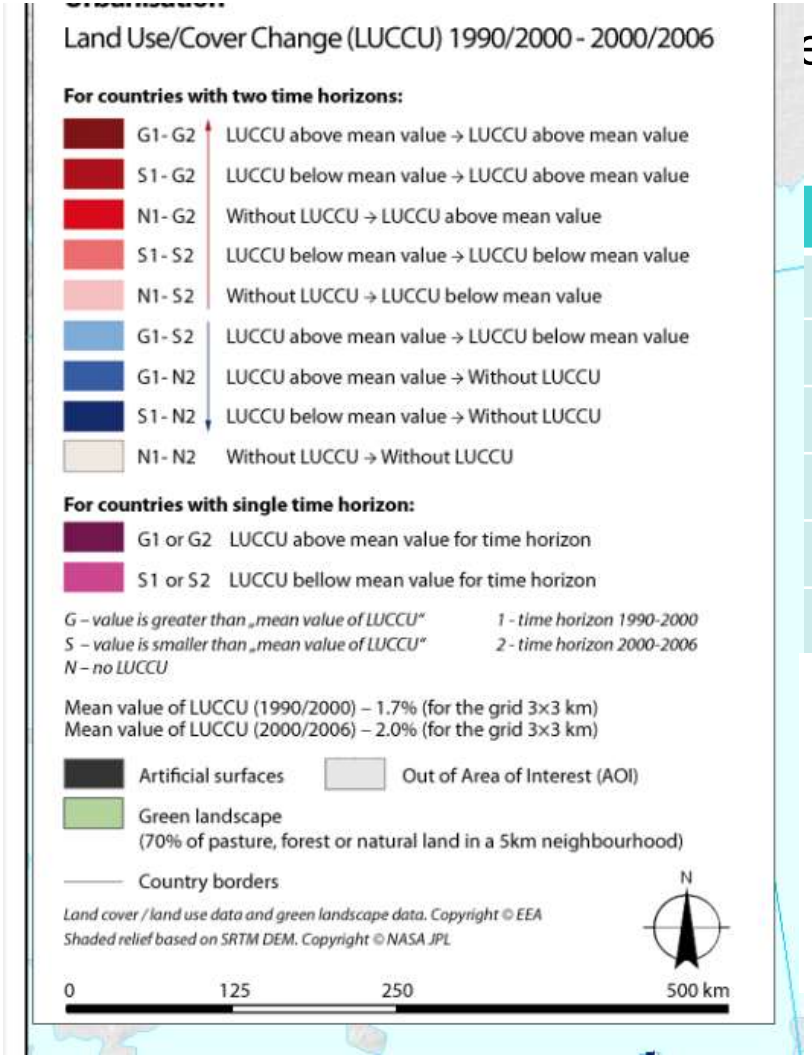
Source:

Chapter:"Overview of changes in land use and land cover in Central Europe" (Jan Feranec, Tomas Soukup, Gregory N. Taff, Premysl Stych and Ivan Bicik)

in the book "Land cover and land use change in Eastern Europe after the collapse of the Soviet Union in 1991" (Editors: Garik Gutman and Volker Radeloff).



Overview of land use and land cover changes in Central and Eastern Europe



e in both periods.

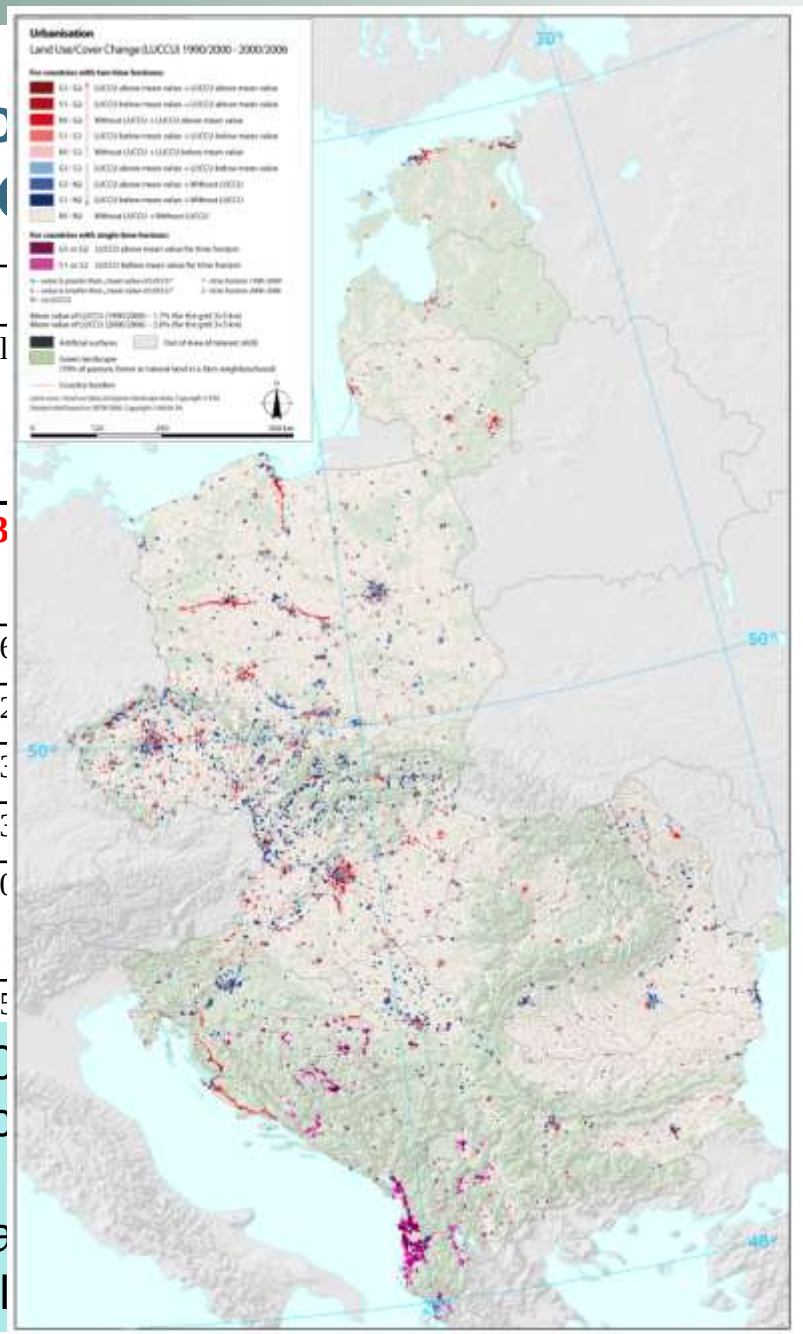
	2000 – 2006
	2.0%
	2.9%
	3.7%
	2.0%
	2.5%
	1.6%

G1 – G2: LUCC above mean value – LUCC above mean value
S1 – G2: LUCC below mean value – LUCC above mean value
N1 – G2: Without LUCC – LUCC above mean value
S1 – S2: LUCC below mean value – LUCC below mean value
N1 – S2: Without LUCC – LUCC below mean value
G1 – S2: LUCC above mean value – LUCC below mean value
G1 – N2: LUCC above mean value – Without LUCC
S1 – N2: LUCC below mean value – Without LUCC
N1 – N2: Without LUCC – Without LUCC

Overview of land use and land cover changes in Central and Eastern Europe

	1990-2000			2000-2006		
	Total area (ha)	Mean yearly increase in the period (ha)	Mean yearly change of total LUCC area (%)	Total area (ha)	Mean yearly increase in the period (ha)	Mean yearly change of total LUCC area (%)
URBANISATION	70,377	7,037.7	3.2	131,143	21,857.2	9.5
INTENSIFICATION	381,648	38,164.8	17.4	114,785	19,130.8	8.3
EXTENSIFICATION	486,275	48,627.5	22.1	93,115	15,519.2	6.7
AFFORESTATION	619,346	61,934.6	28.1	344,569	57,428.2	24.9
DEFORESTATION	580,318	58,031.8	26.4	652,129	108,688.2	47.1
WATER BODIES CONSTRUCTION	17,204	1,720.4	0.8	10,283	1,713.8	0.7
OTHER CHANGES	41,855	4,185.5	1.9	39,715	6,619.2	2.9
Total LUCC area	2,197,023	219,702.3	–	1,385,739	230,956.5	–
Total study area	122,375,321	–		134,022,612	–	

Overview c changes in
(e

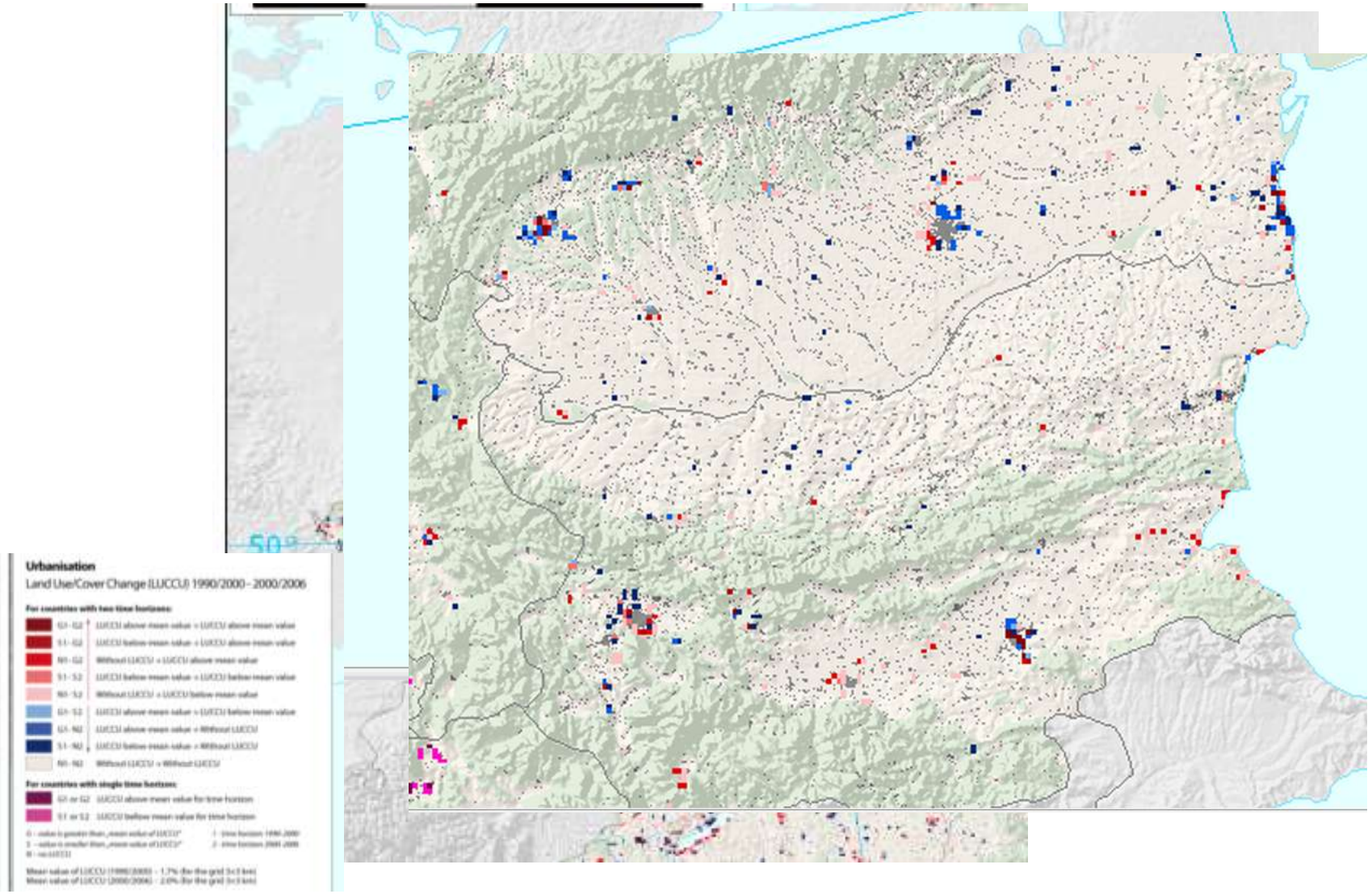


			2000-2006	
	Total	)	Mean yearly increase in the period (ha)	Mean yearly change of total LUCC area (%)
URBANISATION	**70,3**		**21,857.2**	**9.5**
INTENSIFICATION	381,6		19,130.8	8.3
EXTENSIFICATION	486,2		15,519.2	6.7
AFFORESTATION	619,3		57,428.2	24.9
DEFORESTATION	580,3		108,688.2	47.1
WATER BODIES CONSTRUCTION	17,20		1,713.8	0.7
OTHER CHANGES	41,85		6,619.2	2.9

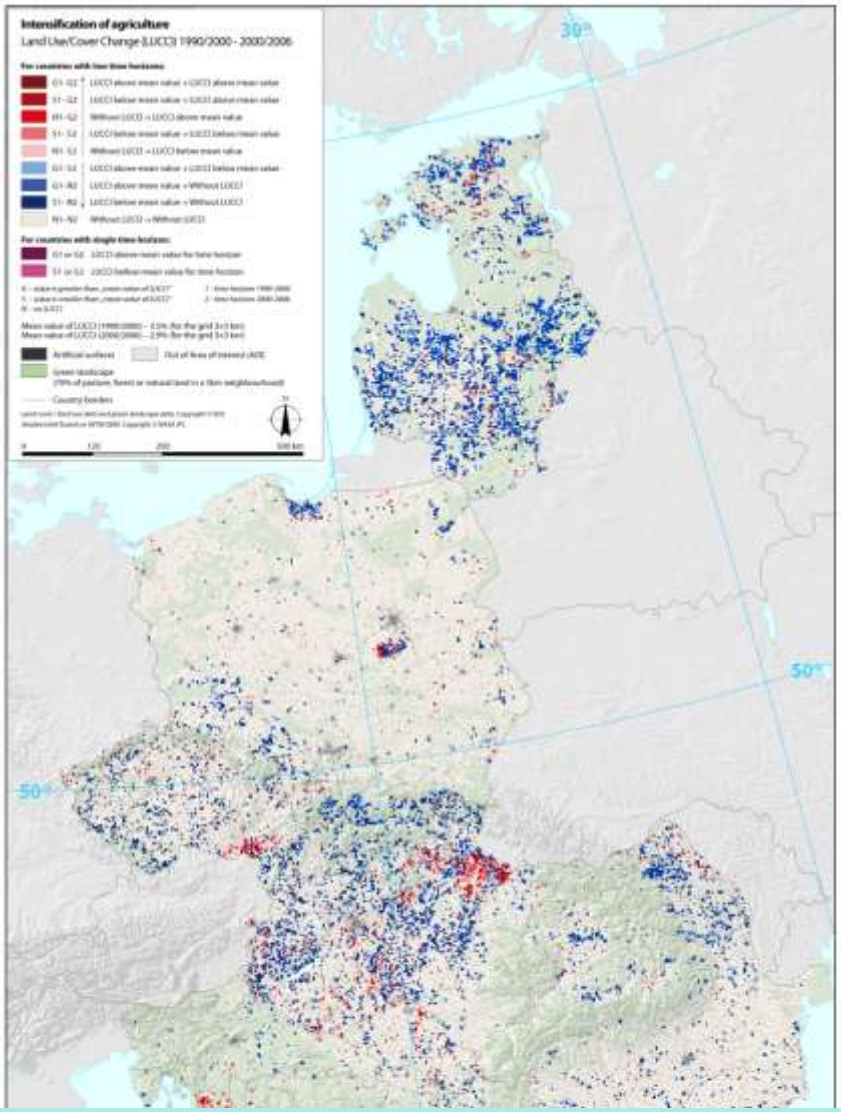
In total, from 1990 %) of the total area experiencing LC c ally as urbanization

During the six-yea 857.2 ha (9.5%) of the total mean annual d to urbanization.

Overview of land use and land cover changes in Central and Eastern Europe



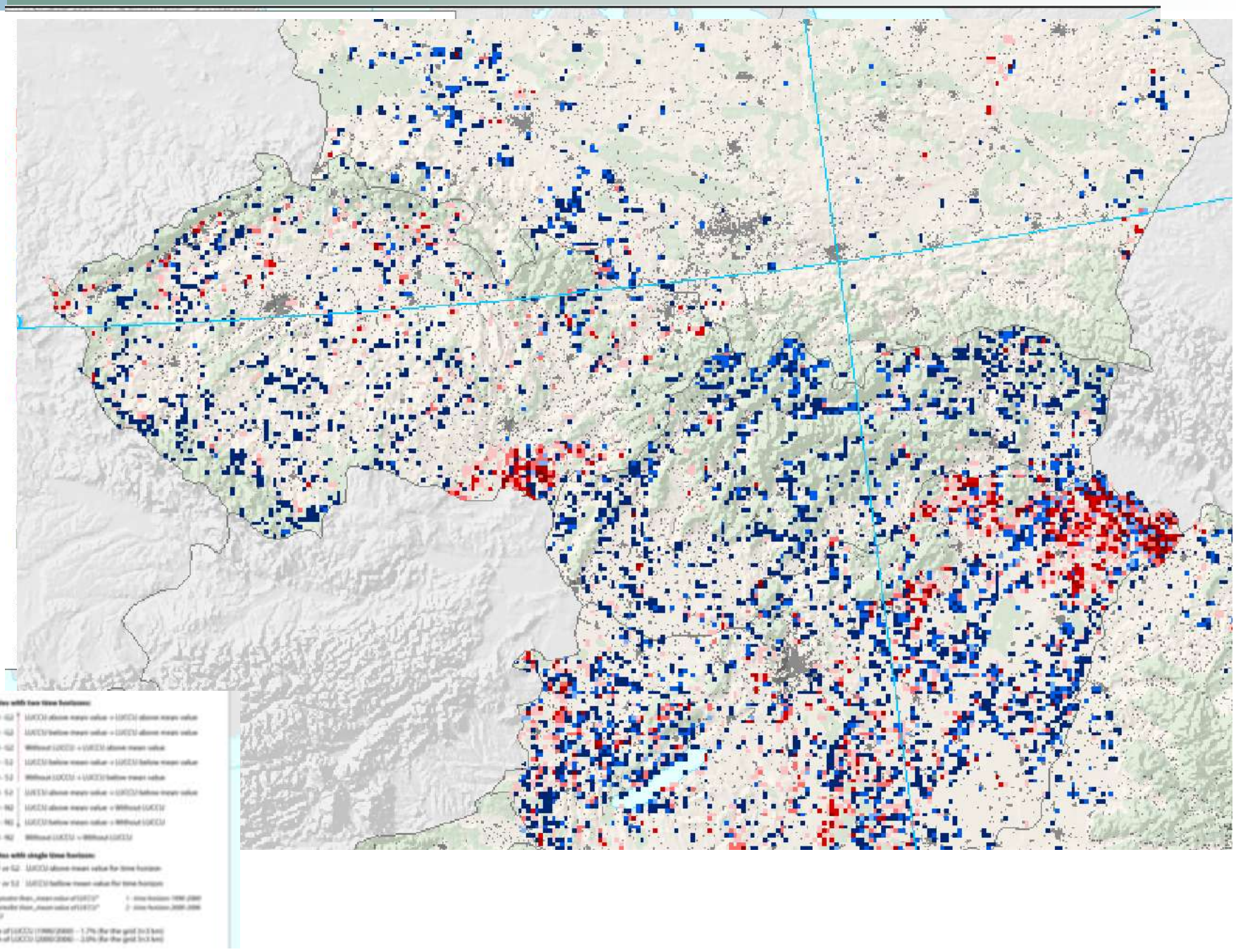
Overview o … anges in …



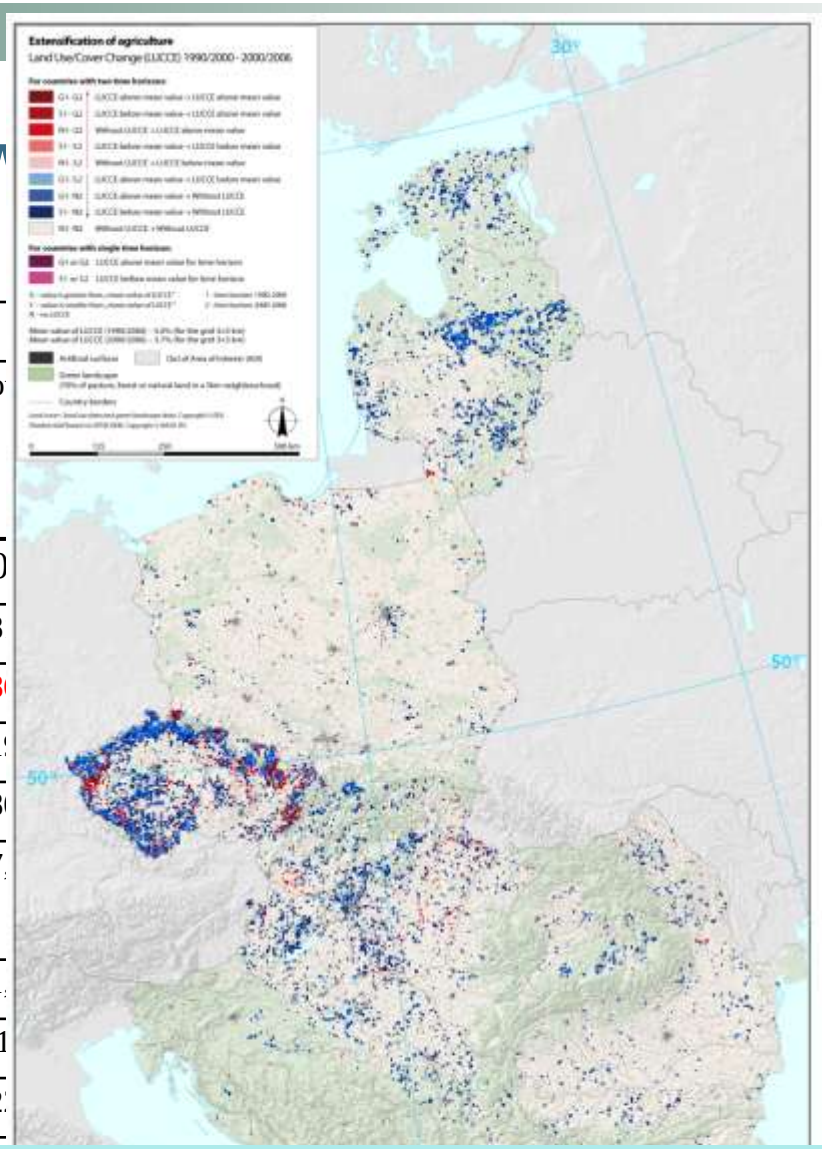
		2000-2006	
	Total are	…ean yearly …crease in the …eriod (ha)	Mean yearly change of total LUCC area (%)
URBANISATION	70,377	…1,857.2	9.5
INTENSIFICATION	**381,648**	**…,130.8**	**8.3**
EXTENSIFICATION	486,275	…,519.2	6.7
AFFORESTATION	619,346	…,428.2	24.9
DEFORESTATION	580,318	…08,688.2	47.1
WATER BODIES CONSTRUCTION	17,204	…713.8	0.7
OTHER CHANGES	41,855	…619.2	2.9
Total LUCC area	2,197,02	…30,956.5	–
T…			

Intensification of agriculture was widespread from 1990-2000, but from 2000-2006 it declined

Exception: intensification of agriculture in north-eastern and central Hungary or in the south-eastern part of the Czech Republic (changes of arable land into vineyards and orchards).



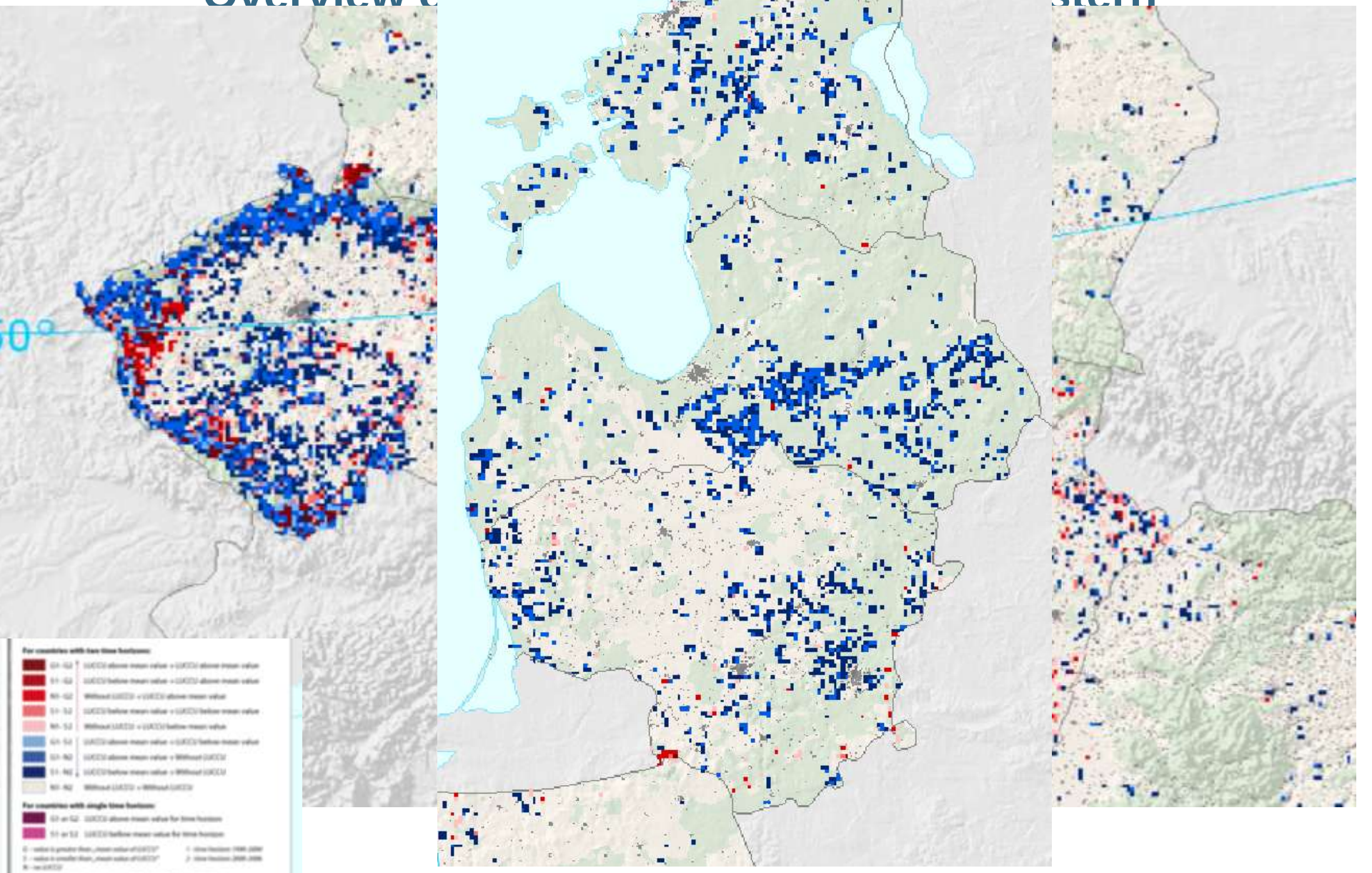
Overview r changes in pe



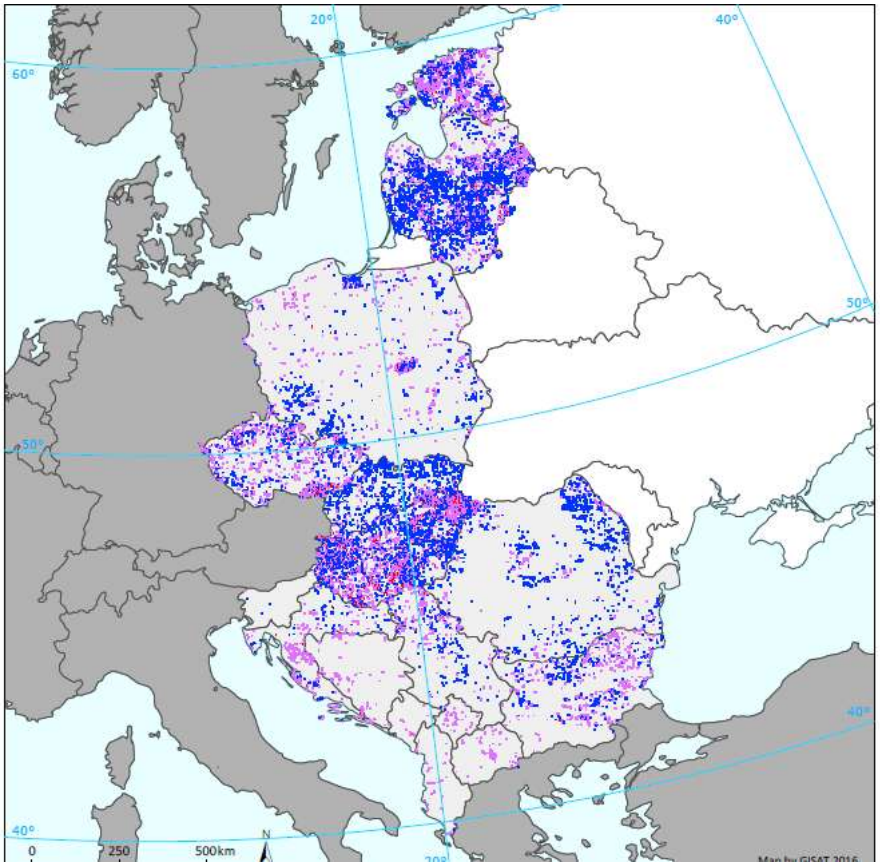
	To	ha)	2000-2006 Mean yearly increase in the period (ha)	2000-2006 Mean yearly change of total LUCC area (%)
URBANISATION	70		21,857.2	9.5
INTENSIFICATION	38		19,130.8	8.3
EXTENSIFICATION	**48**		**15,519.2**	**6.7**
AFFORESTATION	61		57,428.2	24.9
DEFORESTATION	58		108,688.2	47.1
WATER BODIES CONSTRUCTION	17		1,713.8	0.7
OTHER CHANGES	41		6,619.2	2.9
Total LUCC area	2,1		230,956.5	–
Total study area	12	2	–	

Extensification of agriculture occurred most in the northern, western and southern parts of the Czech Republic; the north of Slovakia; in the north and center of Hungary; in Lithuania; Latvia; Estonia, in central and north-eastern parts of Romania

Overview c stern



Overview of changes in Central and Eastern Europe



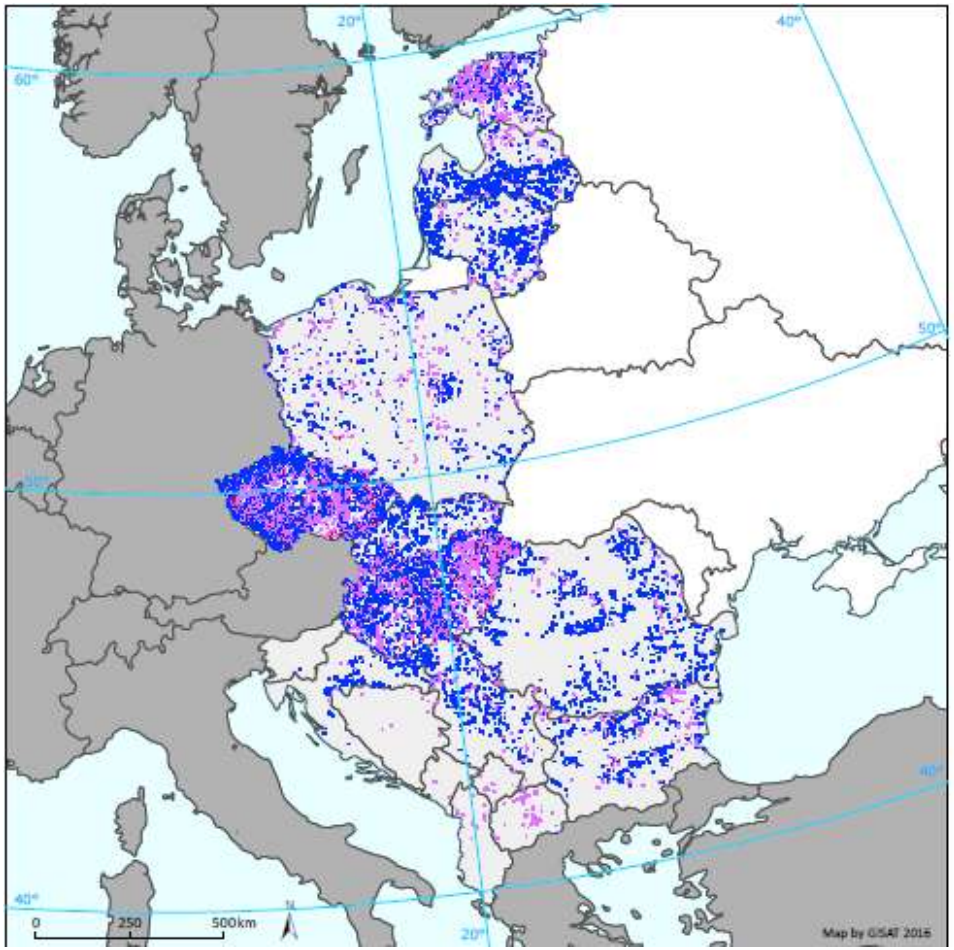
LCFI Intensification of agriculture

Comparison of LCF intensities in periods 2000-2006 and 2006-2012 with that found in 1990-2000

- **Increasing trend** (higher intensity in both periods)
- **Decreasing trend** (lower intensity in both periods)
- **Mixed trend** (higher intenisty in one period, lower in second or the same intensity and changes in countries only with data of two periods 2000-2006 and 2006-2012)

Central European Countries | Other countries covered by CLC data | Countries not covered by CLC data

Overview of changes in Central and Eastern Europe



LCFE Extensification of agriculture

Comparison of LCF intensities in periods 2000-2006 and 2006-2012 with that found in 1990-2000

Increasing trend (higher intensity in both periods)

Decreasing trend (lower intensity in both periods)

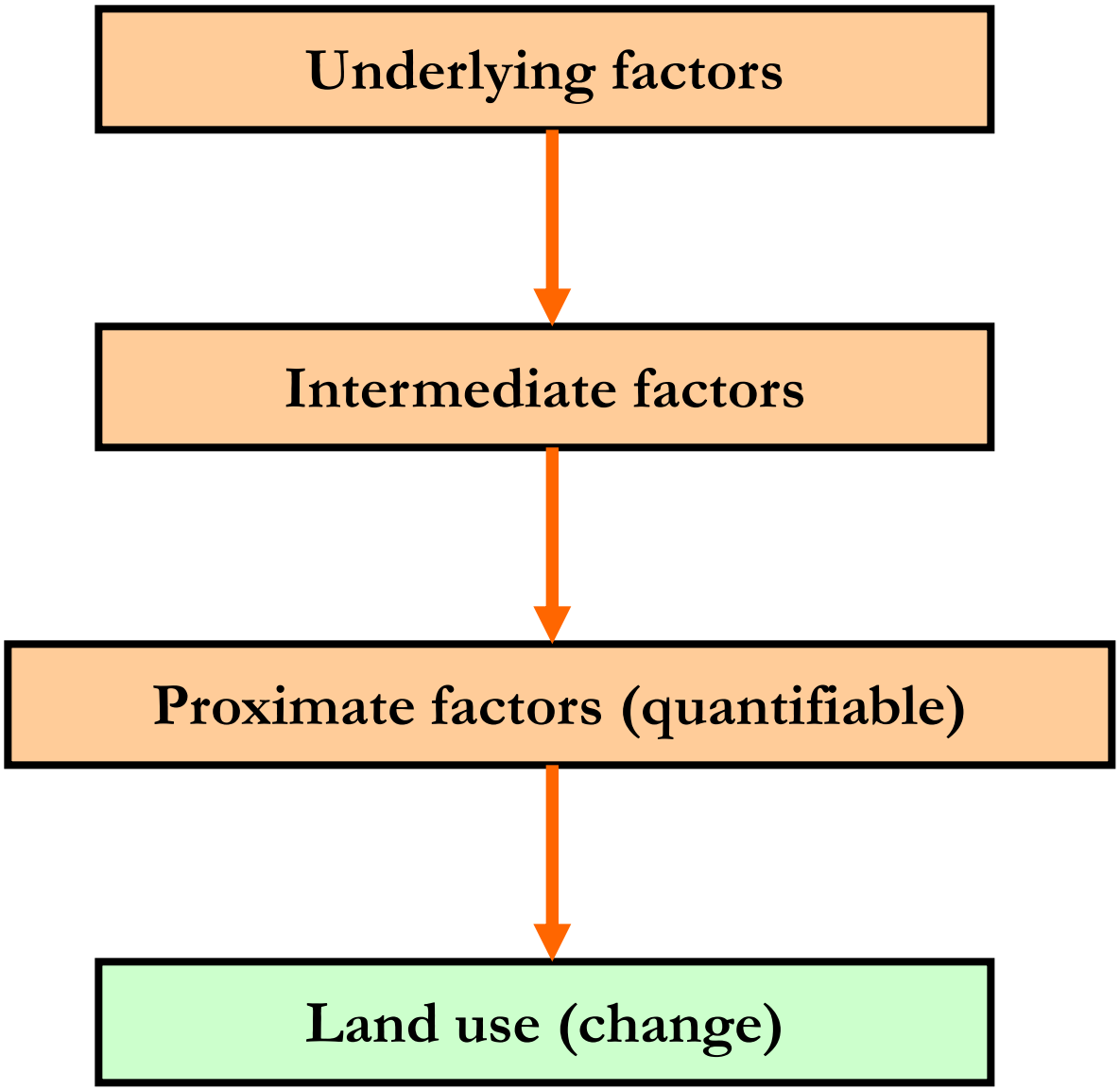
Mixed trend (higher intenisty in one period, lower in second or the same intensity and changes in countries only with data of two periods 2000-2006 and 2006-2012)

Central European Countries | Other countries covered by CLC data | Countries not covered by CLC data

A. Mather: „Multi-level explanatory scheme“

Factors influencing land use changes:

- (1) **proximate** – direct relationship (correlation) with land use (quantifiable indicators – e. g. population)
- (2) **intermediate** – „mode of production“ (economy, technology, transport etc.)
- (3) **underlying** – culture, institutions, policies (laws, habits, attitudes, beliefs, morale, ethic, role of state, interest in environment etc.)


Underlying factors
Intermediate factors
Proximate factors (quantifiable)
Land use (change)

Following steps

- *Follow up the results of the chapter:*
  "Overview of changes in land use and land cover in Central Europe" (Jan Feranec, Tomas Soukup, Gregory N. Taff, Premysl Stych and Ivan Bicik)

  in the book "Land cover and land use change in Eastern Europe after the collapse of the Soviet Union in 1991" (Editors: Garik Gutman and Volker Radeloff).

and

- *Country experts qualitatively explain (based on expert knowledge and review of literature) causes of change stemming from:*

a. *Political reasons*

b. *economic reasons*

c. *Population/social changes*

d. *environmental/climate changes (???)*

Following steps

1) *Share Corine data analysis summary for each country*

2) *Circulate relevant literature – for each country, global*

3) *Each set of country experts use expert knowledge and literature to explain drivers of key changes found in their country (or portion of country) for the time periods we agree upon.*

4) *Determination of who is responsible for each country/portion of country*

Conclusions

- *That is the first draft of paper….*
- *Discussion will be continue tomorrow morning within working session*

Thank you for your attention!

Points for discussion

1. Do we really want/have time/space to do new data analyses within each country, e.g., with population data, etc… my sense is no, or if so, minimal
2. Do we have time/space to study 2 change periods (1990-2000, 2000-2006, 2006-2012)… If we have 10 countries, this is 30 country-time periods – if each gets a half page, this is already 15 pages.
3. The maps are well-designed for scale, a unique look at a continental scale. However, I recommend we change color scheme on the map – it is now a graduated color map, but the classes are not on a continuous scale – for instance, one blue has a very different meaning from another blue.
4. I think listing the importance of drivers in each country through an ordinal methods (1, 2, 3, 4, 5) for political, economic, sociodemographic, etc. will be too difficult for experts to determine, plus it makes a generalization that may not be of real interest to many readers. I think specific drives of changes are more important, such as “In the year 2004, Slovakia joined the EU and the Common Agriculture Policy, which financially motivated people to cut overgrown lands/young forest into pasture, even though the grasses are not used to feed livestock. This has led to significant deforestation in the East.”
5. I think we should get rid of the whole suggested form. I think this would be too much information, especially for 2 or 3 time points in 5-10 countries, and also we won’t have study sites, as I understand the plan. We’ll have experts summarizing the drivers of the trends found in Jan’s analysis.