



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

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Aims

- Overview of land cover/land use changes (spatial distribution and intensity in time) in Central and Eastern Europe during the periods 1990-2000 and 2000-2006,
- Comparison of the change intensity 1990-2000 and 2000-2006
- Differentiation/polarization of LCLUC
- Presentation of methodology of mapping/analyzing landscape changes on a macro-scale
- Proposal of the next steps/actions

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).*
- *two time periods: 1990-2000 and 2000-2006 and*
- *analyzed changes based on the Corine CLC database.*



Background

- *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.*



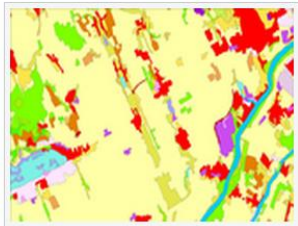
Background

- *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*

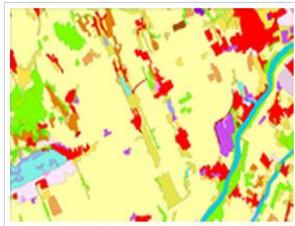


Data sources of the evaluation

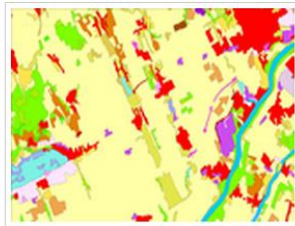
- Corine land cover (CLC) 1990, 2000 and 2006



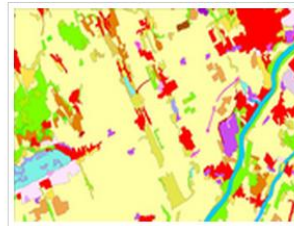
CLC 1990



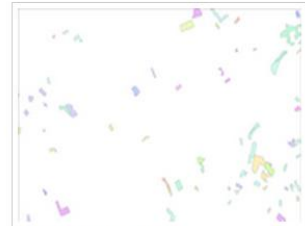
CLC 2000



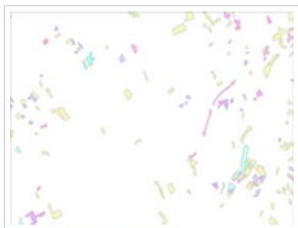
CLC 2006



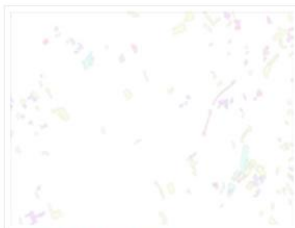
CLC 2012



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 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 et al. 2010).

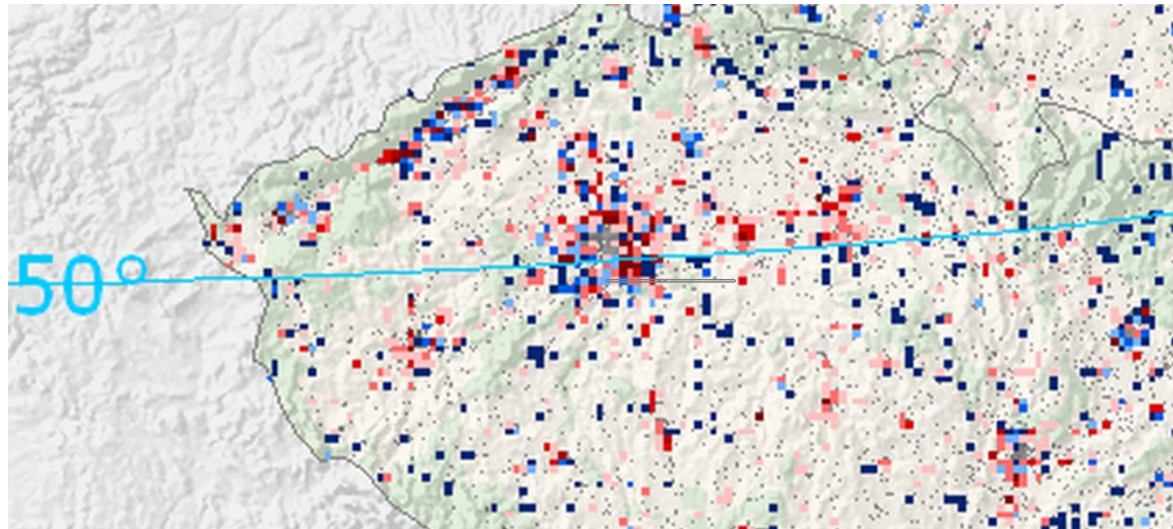
1 – urbanization (industrialisation), 2 – intensification of agriculture, 3 – extensification of agriculture, 4 – afforestation, 5 – deforestation, 6 – water bodies construction and management, 7 – other changes (recultivation, dump sites, unclassified changes, etc.).

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.



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

Land Use/Cover Change (LUCCU) 1990/2000 - 2000/2006

For countries with two time horizons:

	G1 - G2	LUCCU above mean value → LUCCU above mean value
	S1 - G2	LUCCU below mean value → LUCCU above mean value
	N1 - G2	Without LUCCU → LUCCU above mean value
	S1 - S2	LUCCU below mean value → LUCCU below mean value
	N1 - S2	Without LUCCU → LUCCU below mean value
	G1 - S2	LUCCU above mean value → LUCCU below mean value
	G1 - N2	LUCCU above mean value → Without LUCCU
	S1 - N2	LUCCU below mean value → Without LUCCU
	N1 - N2	Without LUCCU → Without LUCCU

For countries with single time horizon:

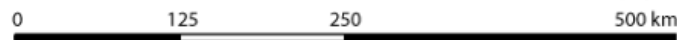
	G1 or G2	LUCCU above mean value for time horizon
	S1 or S2	LUCCU below mean value for time horizon

G – value is greater than „mean value of LUCCU“ 1 - time horizon 1990-2000
 S – value is smaller than „mean value of LUCCU“ 2 - time horizon 2000-2006
 N – no LUCCU

Mean value of LUCCU (1990/2000) – 1.7% (for the grid 3x3 km)
 Mean value of LUCCU (2000/2006) – 2.0% (for the grid 3x3 km)

	Artificial surfaces		Out of Area of Interest (AOI)
	Green landscape (70% of pasture, forest or natural land in a 5km neighbourhood)		
	Country borders		

Land cover / land use data and green landscape data. Copyright © EEA
 Shaded relief based on SRTM DEM. Copyright © NASA JPL



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

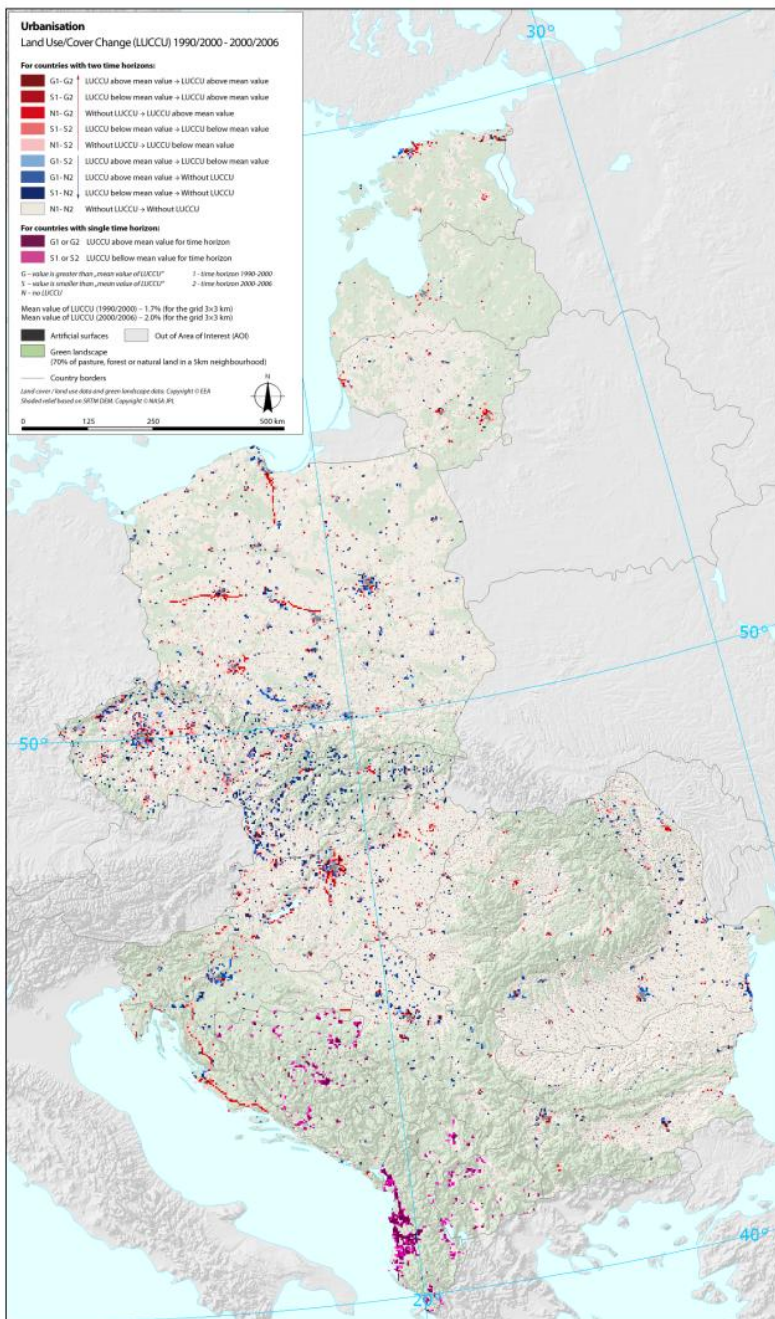
Overview of land use and land cover changes in Central and Eastern Europe

	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 of

changes in

	Total
URBANISATION	70,3
INTENSIFICATION	381,6
EXTENSIFICATION	486,2
AFFORESTATION	619,3
DEFORESTATION	580,3
WATER BODIES CONSTRUCTION	17,20
OTHER CHANGES	41,85



	2000-2006	
)	Mean yearly increase in the period (ha)	Mean yearly change of total LUCC area (%)
	21,857.2	9.5
	19,130.8	8.3
	15,519.2	6.7
	57,428.2	24.9
	108,688.2	47.1
	1,713.8	0.7
	6,619.2	2.9

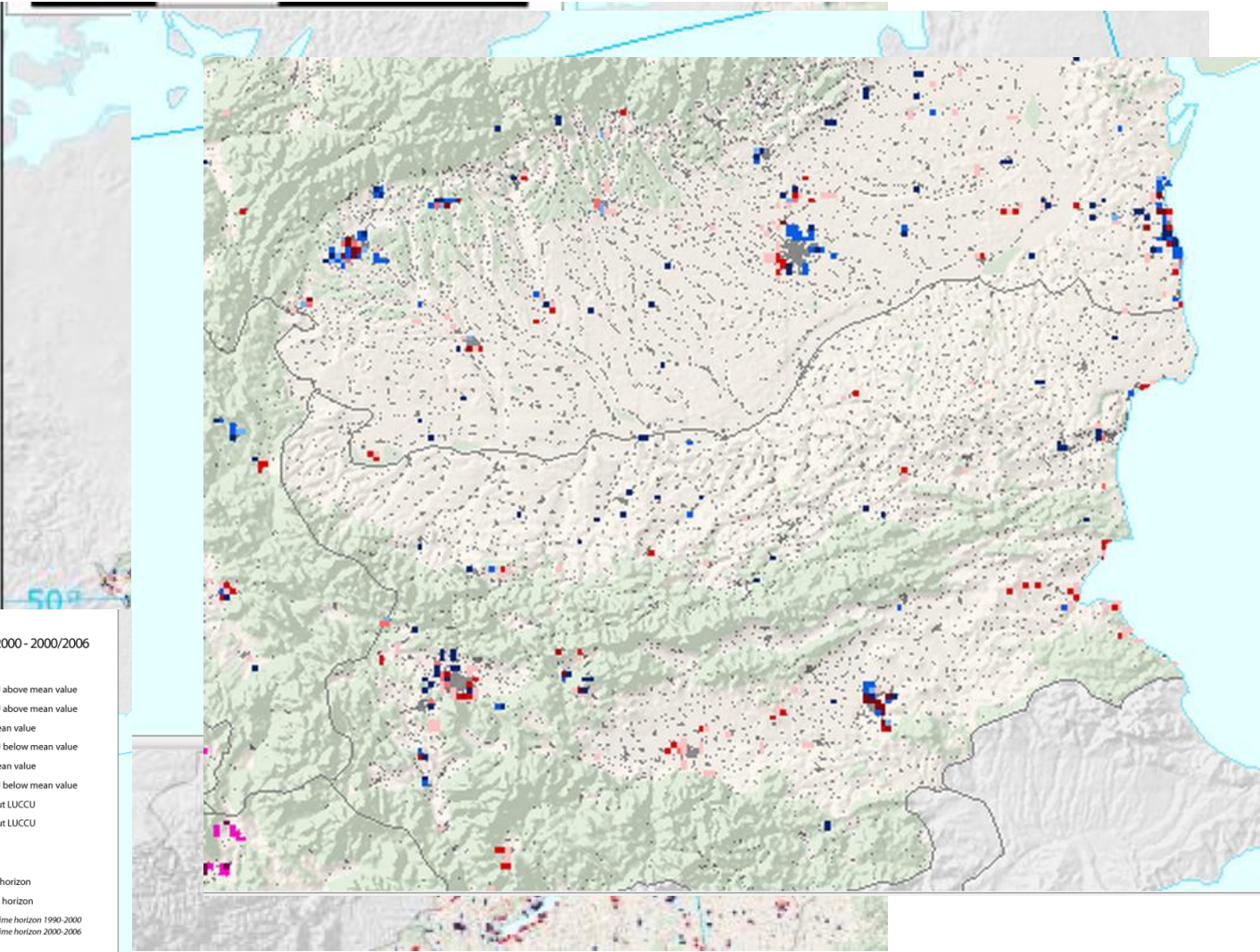
In total, from 1990 experiencing LC c

During the six-year total mean annual

%) of the total area ally as urbanization

857.2 ha (9.5%) of the ed to urbanization.

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



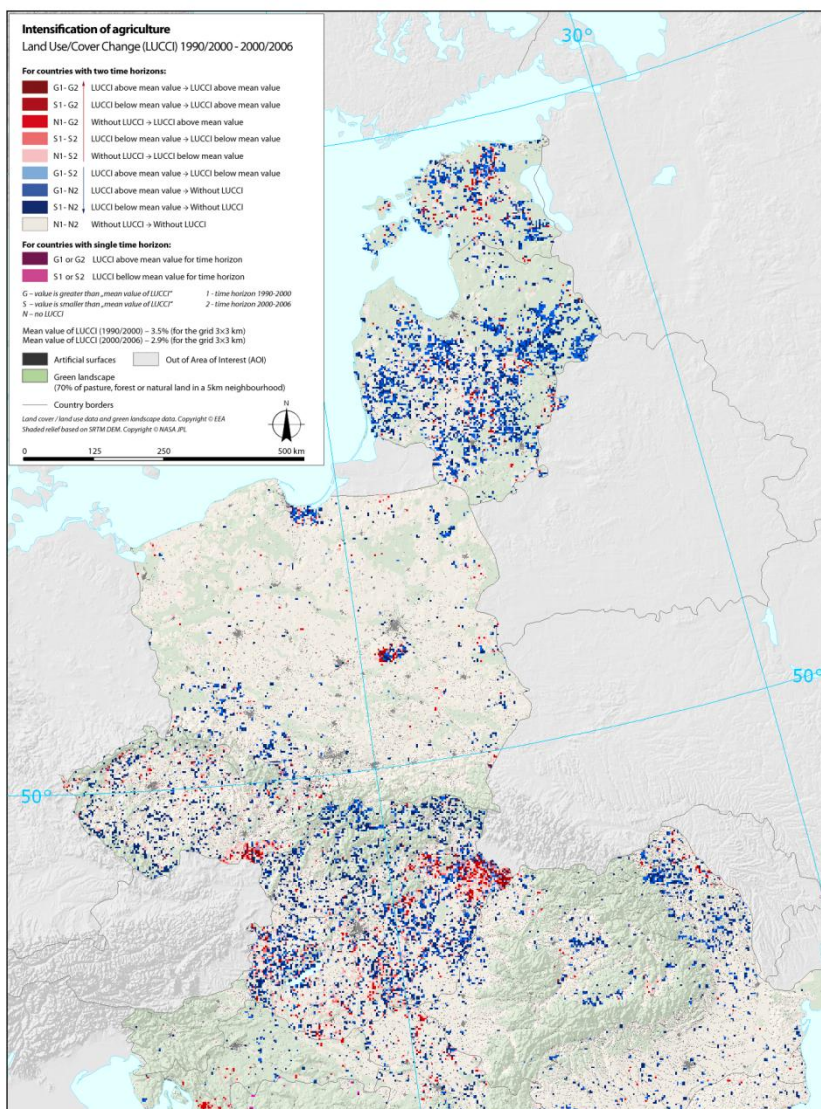
Urbanisation
Land Use/Cover Change (LUCCU) 1990/2000 - 2000/2006

- For countries with two time horizons:**
- G1-G2 | LUCU above mean value → LUCU above mean value
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Overview of

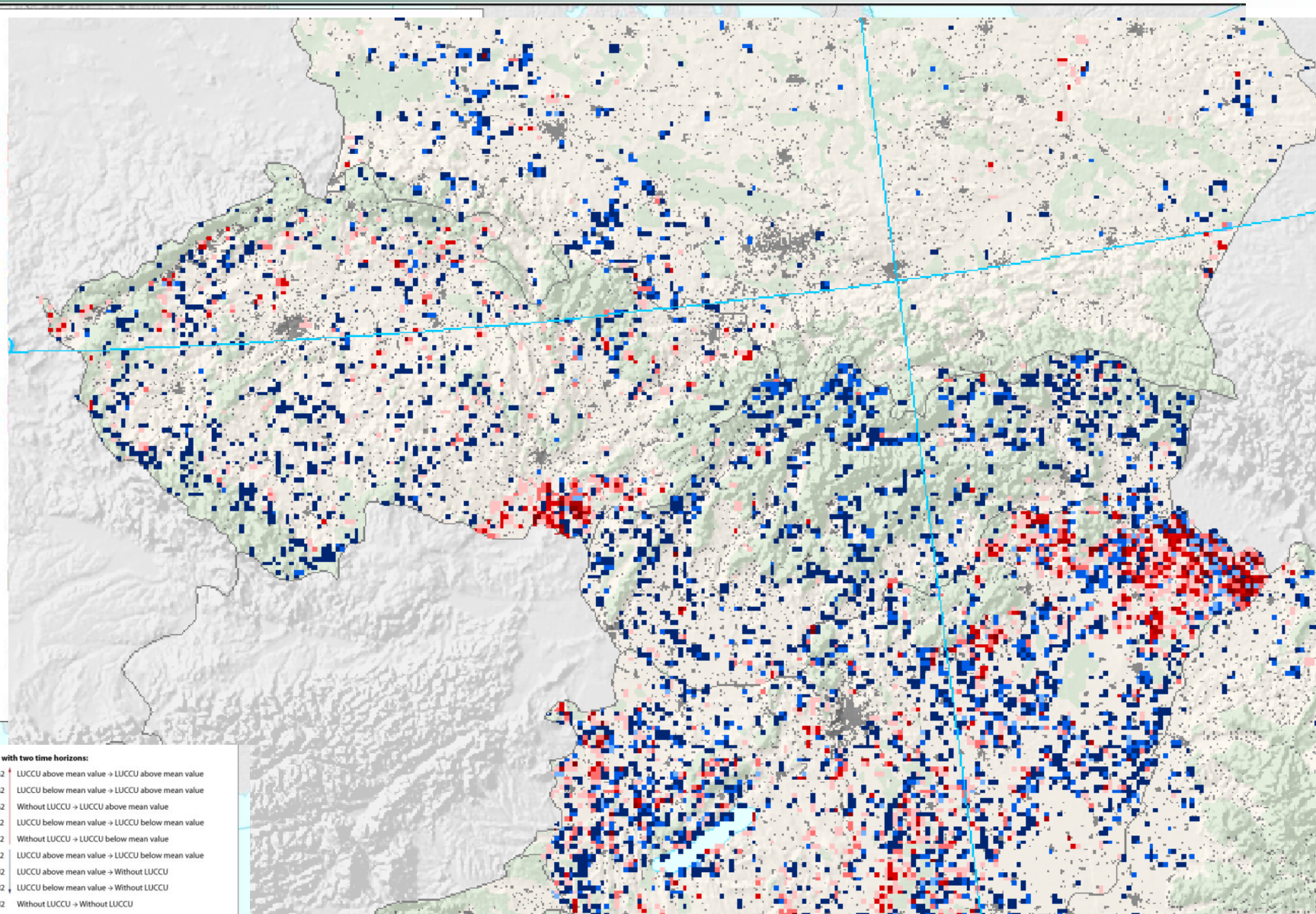
Changes in

	Total area
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EXTENSIFICATION	486,275
AFFORESTATION	619,346
DEFORESTATION	580,318
WATER BODIES CONSTRUCTION	17,204
OTHER CHANGES	41,855
Total LUCC area	2,197,02



2000-2006	
Mean yearly crease in the period (ha)	Mean yearly change of total LUCC area (%)
1,857.2	9.5
1,130.8	8.3
1,519.2	6.7
1,428.2	24.9
18,688.2	47.1
713.8	0.7
619.2	2.9
10,956.5	—

The 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).



For countries with two time horizons:

- G1-G2 LUCCU above mean value → LUCCU above mean value
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- N1-N2 Without LUCCU → Without LUCCU

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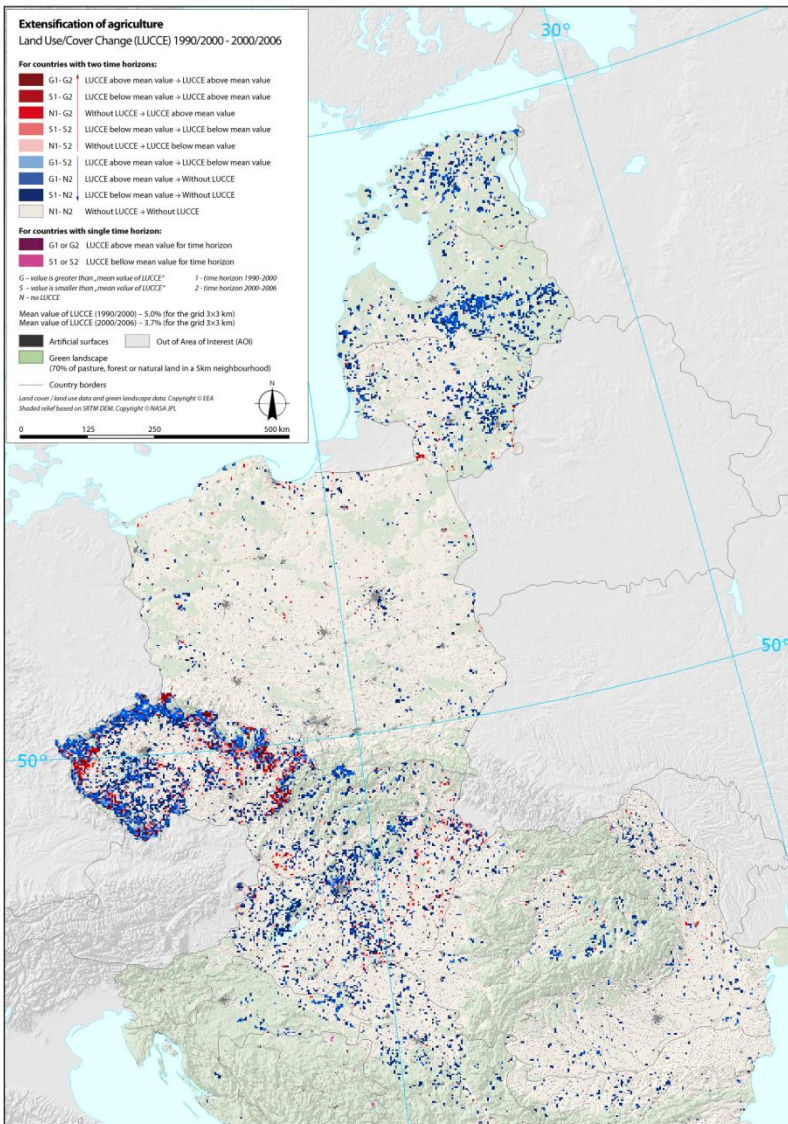
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Overview

	To
URBANISATION	70
INTENSIFICATION	38
EXTENSIFICATION	48
AFFORESTATION	61
DEFORESTATION	58
WATER BODIES CONSTRUCTION	17
OTHER CHANGES	41
Total LUCC area	2,1
Total study area	12.



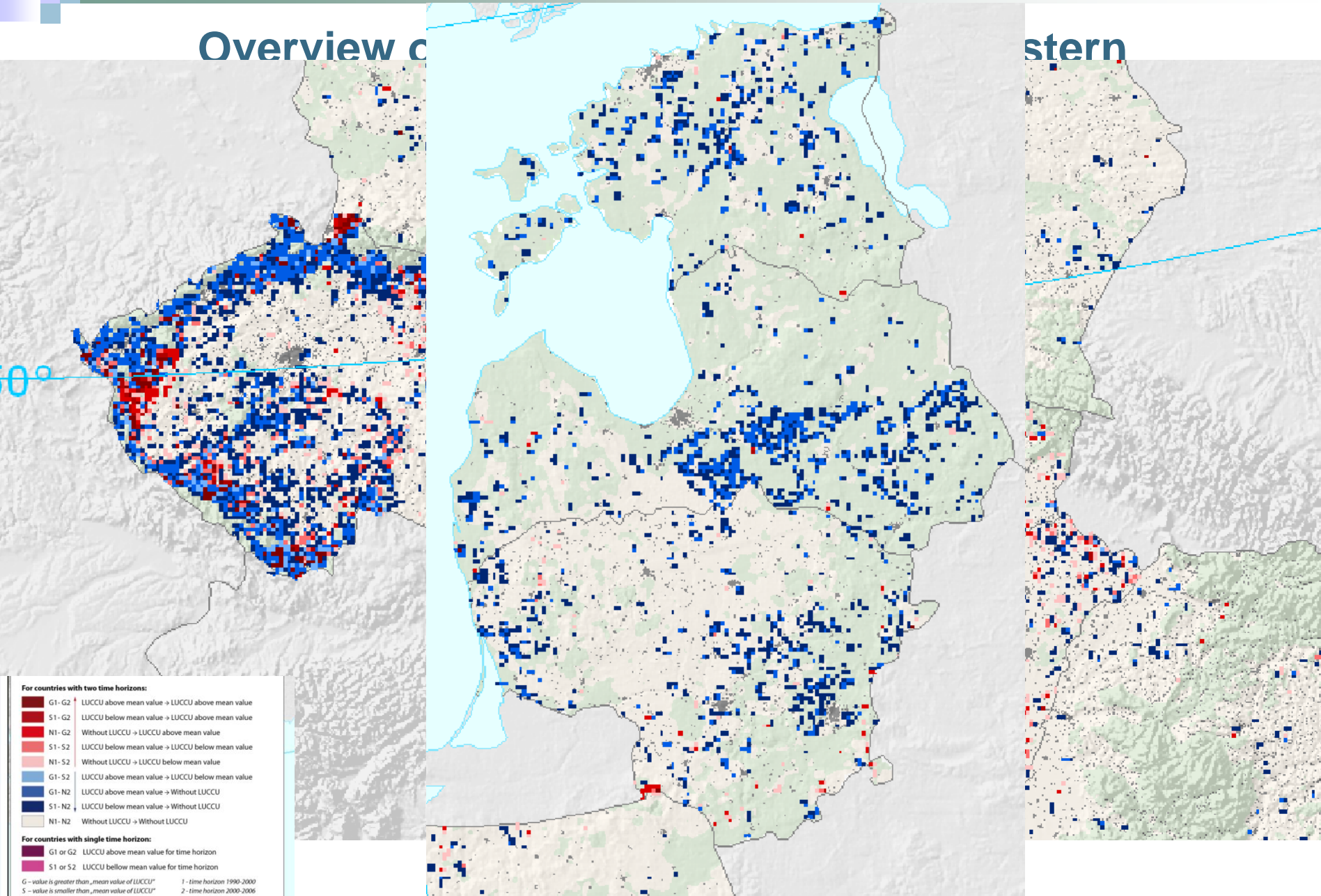
Changes in LUCC type

	2000-2006	
ha)	Mean yearly increase in the period (ha)	Mean yearly change of total LUCC area (%)
	21,857.2	9.5
	19,130.8	8.3
	15,519.2	6.7
	57,428.2	24.9
	108,688.2	47.1
	1,713.8	0.7
	6,619.2	2.9
	230,956.5	—
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 of

Western



For countries with two time horizons:

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For countries with single time horizon:

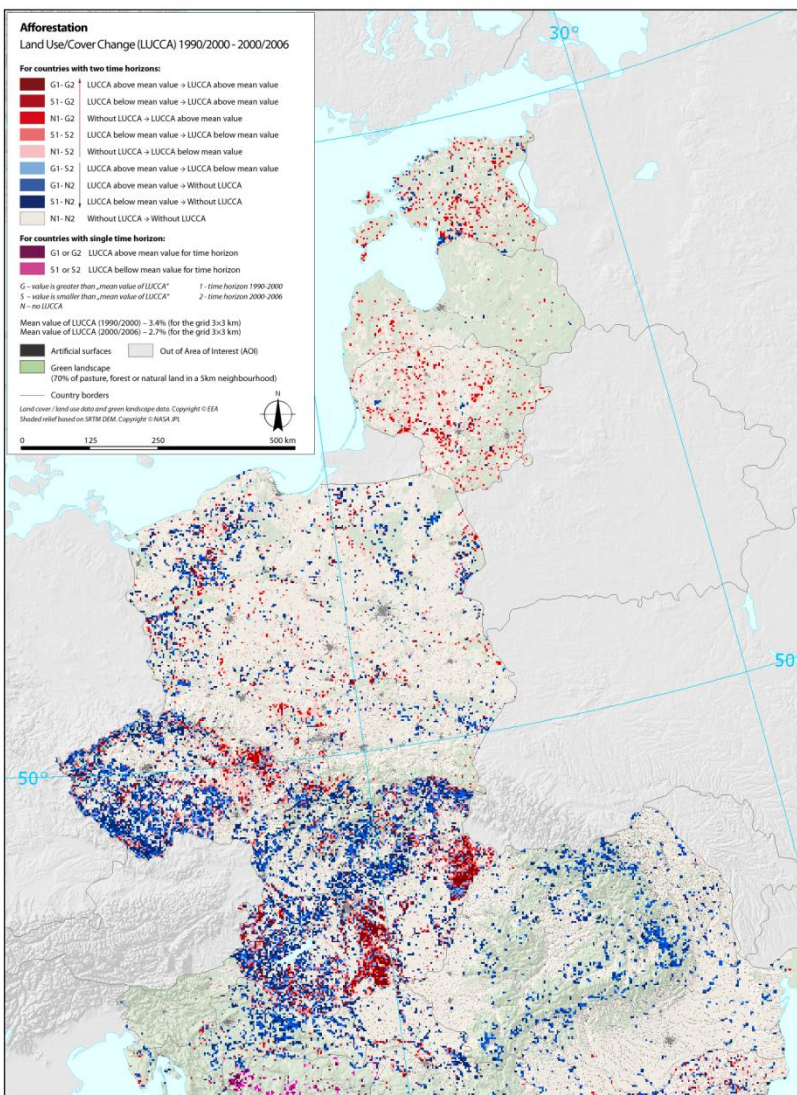
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Overview

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INTENSIFICATION	38
EXTENSIFICATION	48
AFFORESTATION	61
DEFORESTATION	58
WATER BODIES CONSTRUCTION	17
OTHER CHANGES	41
Total LUCC area	2,1



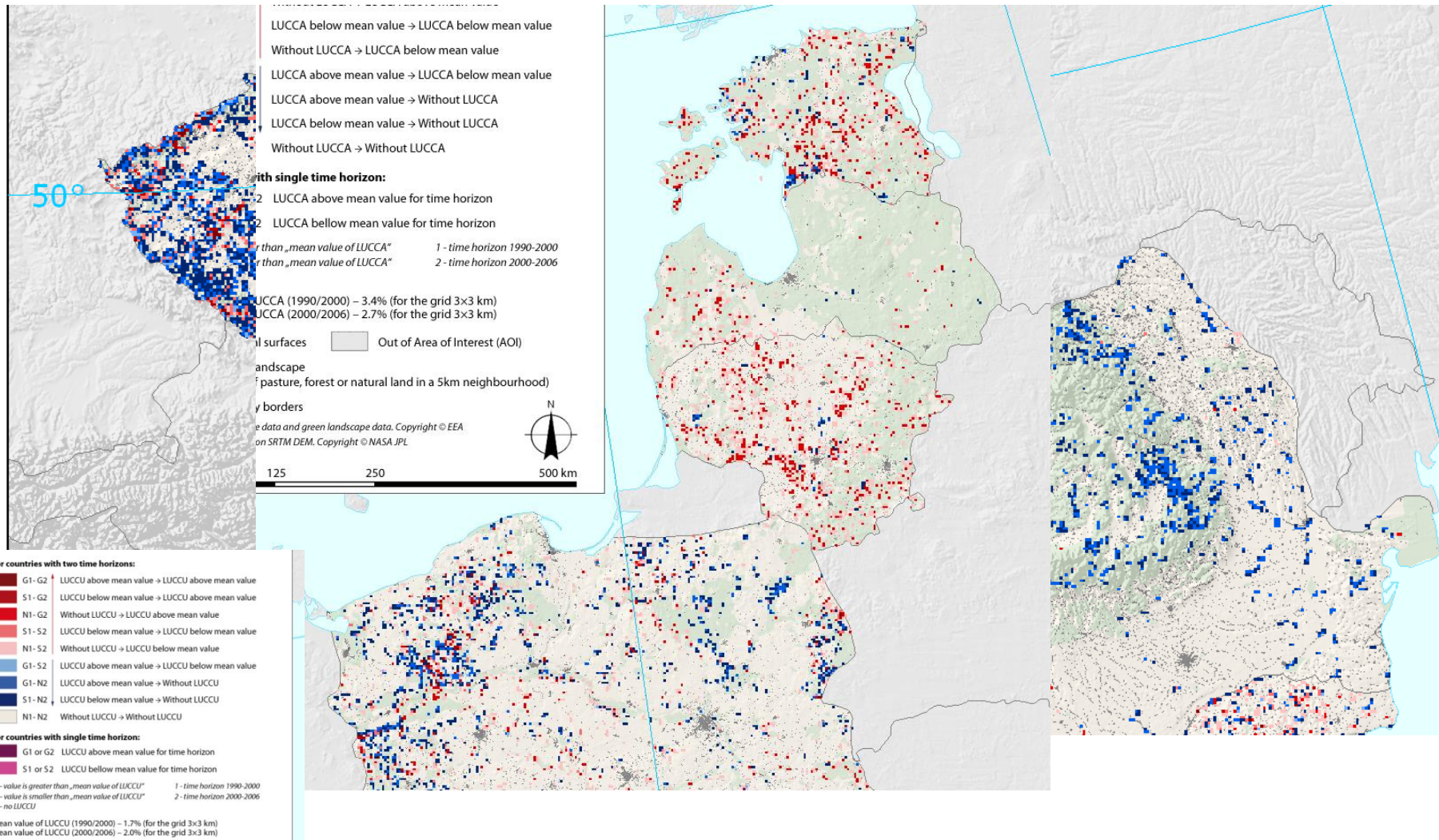
changes in pe

2000-2006		
a)	Mean yearly increase in the period (ha)	Mean yearly change of total LUCC area (%)
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	57,428.2	24.9
	108,688.2	47.1
	1,713.8	0.7
	6,619.2	2.9
	230,956.5	—

This was the most extensive change in the first period, second in the second period

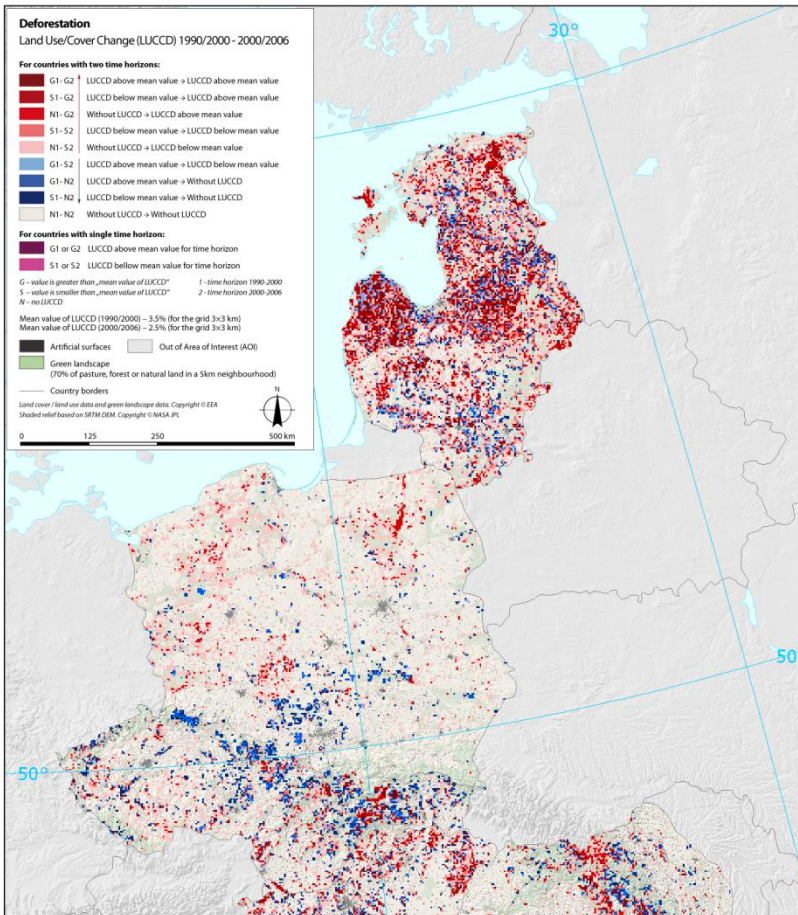
Changes in Hungary, in the Czech Republic, and in Lithuania and Estonia, in the central part of Slovakia; in central and eastern Romania; central Bulgaria and south-eastern Serbia.

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



Overview

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URBANISATION	70,3'
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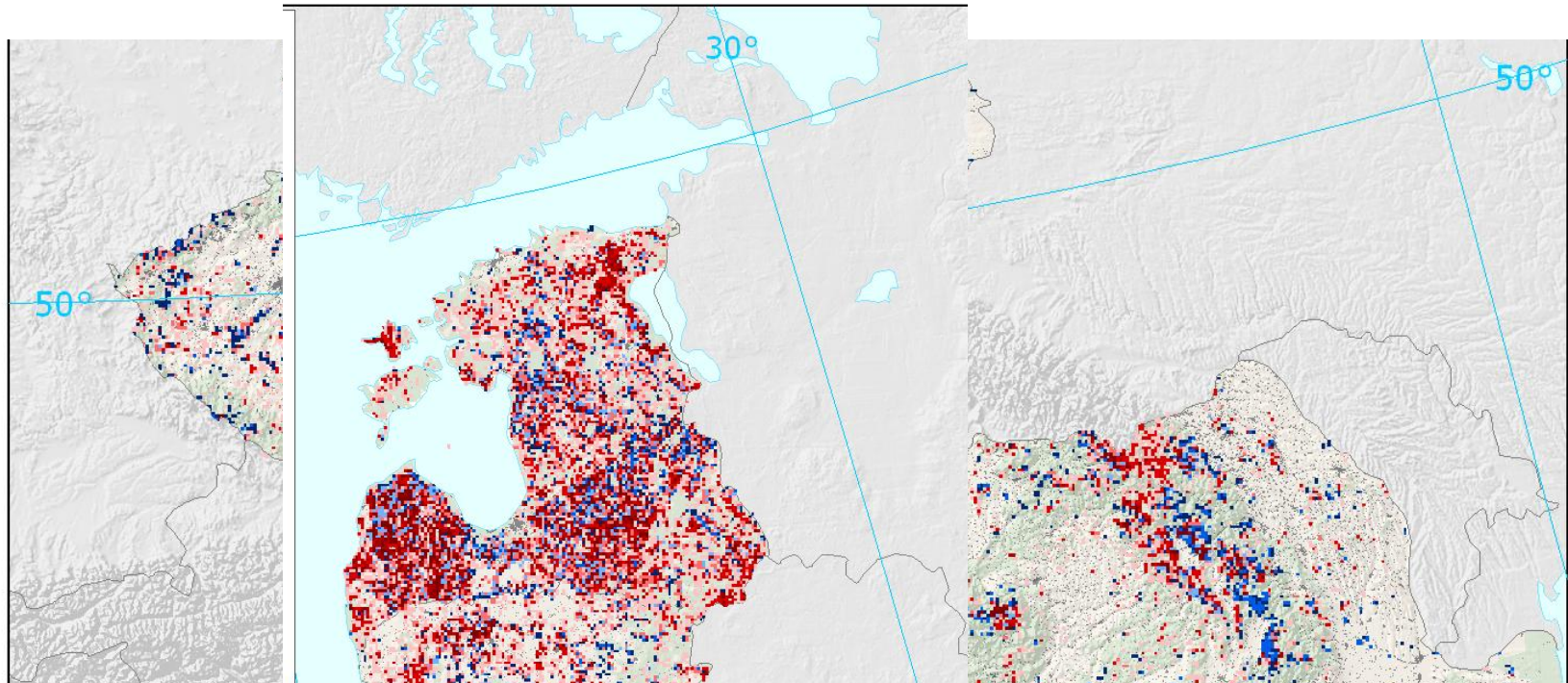


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Deforestation was the second most common LC change in the 1990s, in the second period, deforestation became the biggest land cover change in Eastern Europe, The most extensive areas of deforestation occurred in Latvia, Estonia and Lithuania; in Hungary; the north-eastern part of Romania and in northern Slovakia, in Poland, the northern part of Bulgaria and in north-eastern Croatia, in the Czech Republic.

Overview of changes in Central and Eastern Europe



For countries with two time horizons:

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Conclusions

- *The area of identified LUCC in 1990-2000 was approximately 21 970 km², and in 2000-2006 it was approximately 13 860 km²*
- *The greatest changes occurred as afforestation and deforestation, totaling 54.5% of the total LUCC area in 1990-2000 and 72.0% of the total LUCC area in 2000-2006.*
- *Significant changes occurred on agricultural lands in the study region. Two antagonistic trends – extensification and intensification were documented.*
- *Extensification (mainly over-grassing) was a prominent trend, especially in Central Europe (the north, western, south-western and north-eastern parts of the Czech Republic, and the north-western part of Slovakia and in the Baltic states in the first period (1990-2000)).*
- *Urbanisation was concentrated in the largest core population areas (big cities) into which the main flows of investment were aimed and was the third most common trend in the second period with almost 10% of the total LUCC area. The intensity of urbanisation, was three times higher in 2000-2006 than in the first period.*

Conclusions

- *Territorial differences in LUCC trends are possible to find in the study area. Countries in the central part of study area were affected by more intensive changes, and by a wider spectrum of changes (often antagonistic: intensification and urbanization as well as land abandonment and afforestation).*
- *The second most intensive changes occurred in the Baltic states, especially on agricultural and forest lands.*
- *On the other hand, the southern countries (e.g. Bulgaria, Bosnia-Herzegovina, Monte Negro), Slovenia and the central parts of Poland experienced an overall lower intensity of changes.*
- *Next actions:*
 - New time period 2006-2012*
 - Validation of results by different type of data, case studies*
 - Drivers of changes*



Thank you for your attention!

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