SCERIN 5 – Pecs, Hungary, 2017
Posters speed talks
(2 minutes highlights)

FG2: Land Cover Changes

First name	Last name
Noémi	Eőry
Stanisław	Lewiński
Minučer	Mesaroš
Mykola	Meretskyi
Brice	Mora
Luka	Rumora
Volodymyr	Starodubtsev
Premysl	Stych
Rumiana	Vatseva

Utilization of Earth Observation technology in waste deposition detection – 1st steps of a development project (REMEDI)

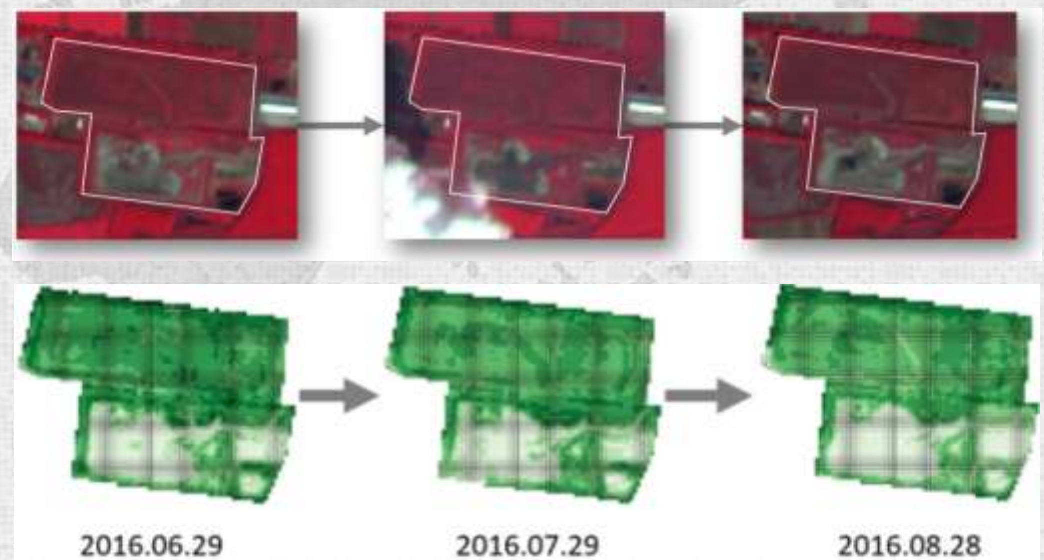
Dr. Györk Fülöp, **Noémi Eőry**, Ármin Cséve

REMEDI EUREKA (EUREKA_15-1-2016-0023; E! 9969).
http://www.eurekanetwork.org/project/id/9969

Examination of the changes of the vegetation

- ✓ Time series changes
- ✓ Three main cases: active, rehabilitated and partially rehabilitated
- ✓ Partially rehabilitated:

Google Earth
2016.06.19.



GEOADAT Szolgáltató Kft.

Inside and outside examination

- ✓ Inside: forests and reservoirs
- ✓ Outside: distances of the waste depositions from the natural waters and urban areas

GEOADAT Szolgáltató Kft.

THANK YOU FOR YOUR ATTENTION!

REMEDI EUREKA (EUREKA_15-1-2016-0023; E! 9969).

http://www.eurekanetwork.org/project/id/9969

Noémi Eőry

www.geoadat.hu

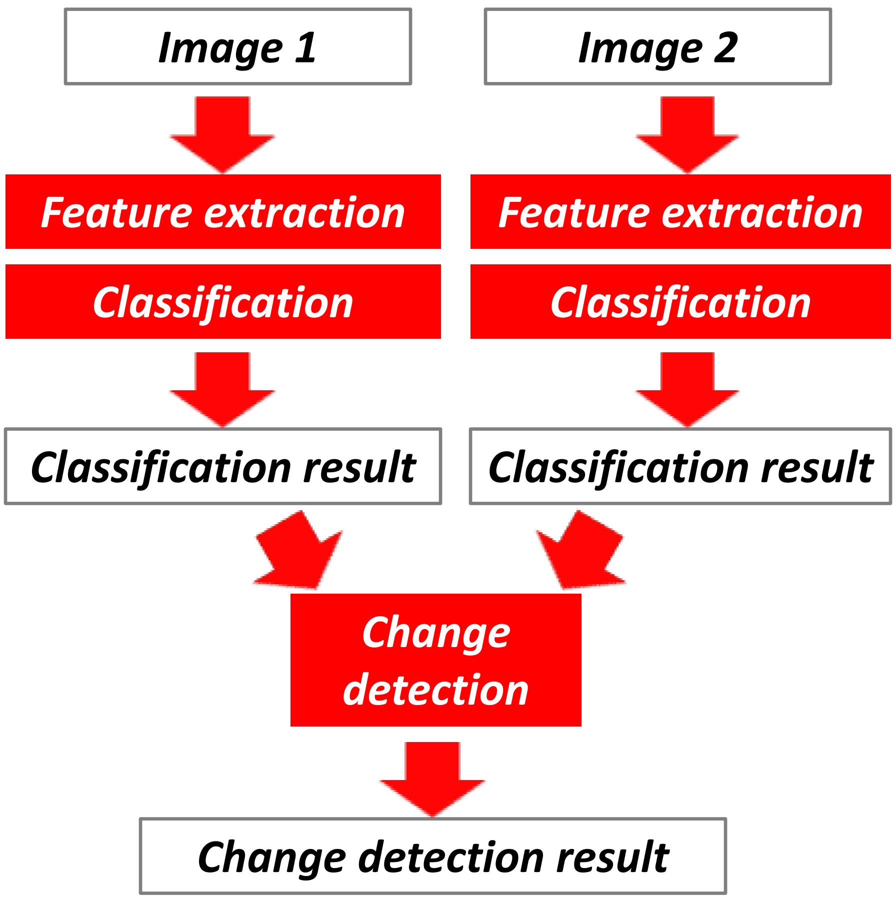
geoadat@geoadat.hu

A projekt megvalósítását a NKTIA és az EUREKA program támogatta.

AUTOMATIC SELECTION OF CLASSIFICATION THRESHOLDS FOR CHANGE DETECTION IN LAND COVER

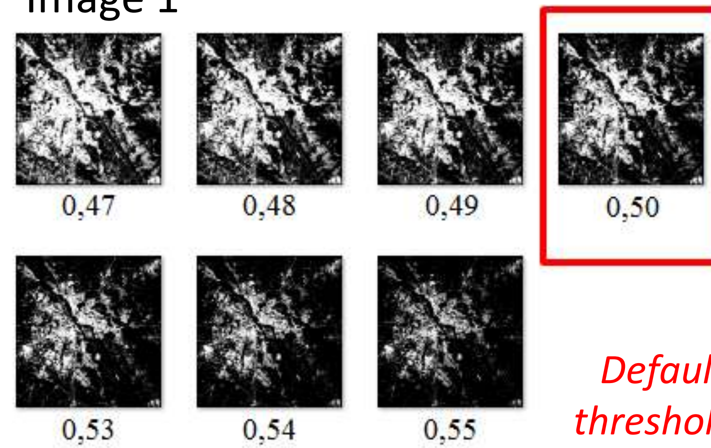
SPACE RESEARCH CENTRE OF THE POLISH ACADEMY OF SCIENCES
Artur Nowakowski Stanisław Lewiński
anowakowski@cbk.waw.pl *stlewinski@cbk.waw.pl*

CHANGE DETECTION WORKLFOW



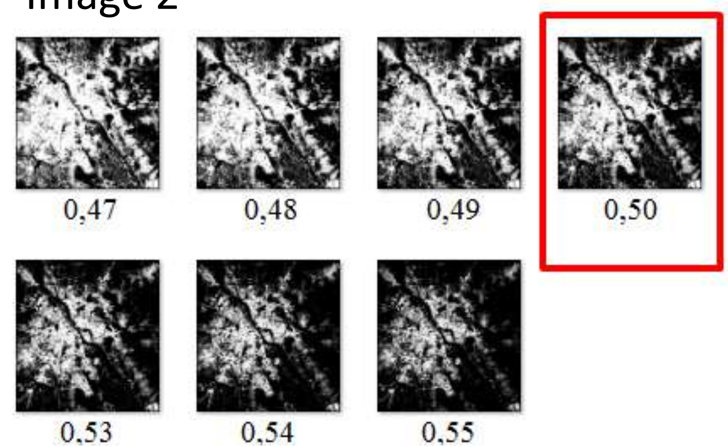
CLASSIFICATION of built-up areas

Image 1



Default thresholds

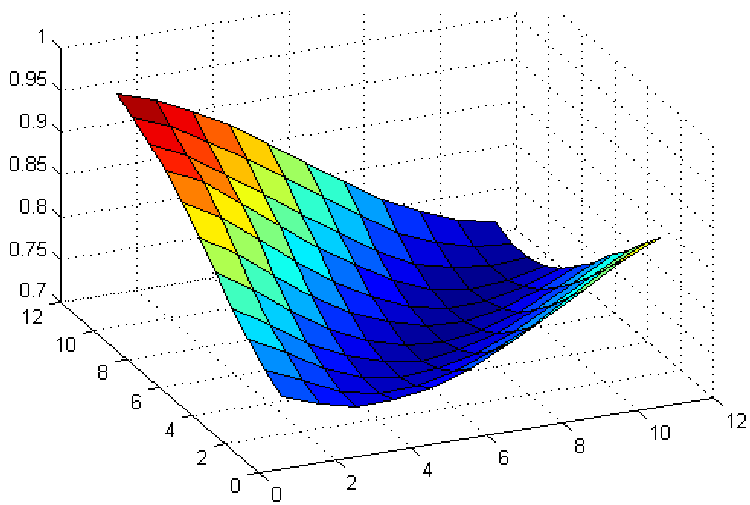
Image 2

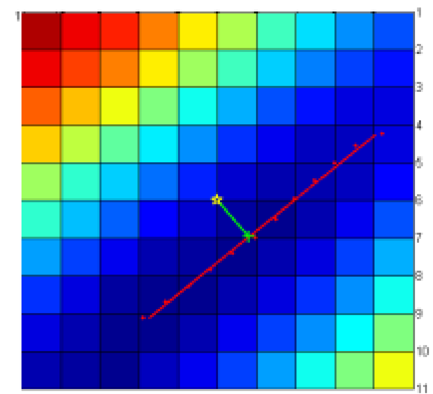


AUTOMATIC THRESHOLD SELECTION

Two sets of classifications with different parameters for the first and the second image are performed, results are compared according to *m* function.

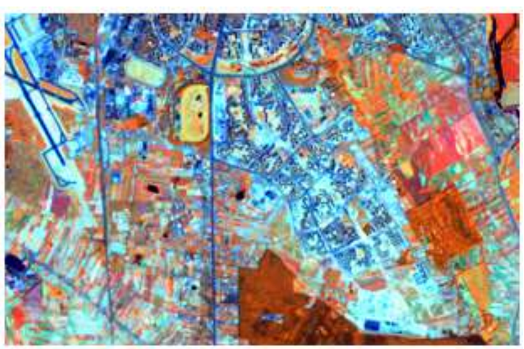
$$m = \frac{\sum_{i=1}^{yres}\sum_{j=1}^{xres}(e_{C1}(i,j)-e_{C2}(i,j))\neq 0}{\left(\sum_{i=1}^{yres}\sum_{j=1}^{xres}(e_{C1}(i,j))=1\right)+\left(\sum_{i=1}^{yres}\sum_{j=1}^{xres}(e_{C2}(i,j))=1\right)}$$



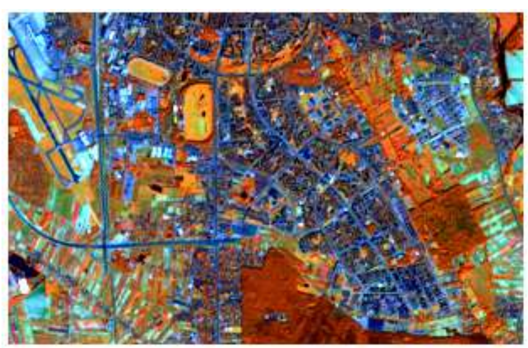


τ_{1994} = 0,492 τ_{2013} = 0,510

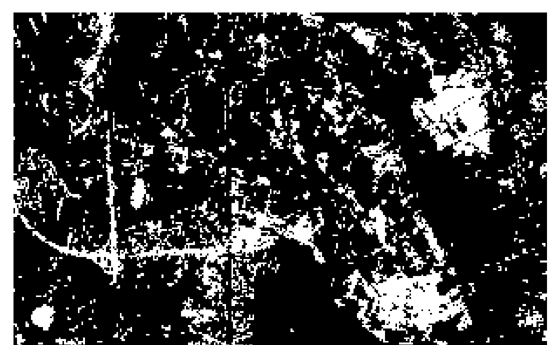
Landsat 1994



Landsat 2013



Improved change detection



REMOTE SENSING IN WATER MANAGEMENT AND AGRICULTURE IN SERBIA

Mészáros Minucsér,

Department of Geography, Tourism and Hotel Management

Faculty of Sciences,

University of Novi Sad

PROBLEMS AND CHALENGES IN AGRICULTURE AND WATER MANAGEMENT IN SERBIA

WATERLOGGING
(INLAND EXCESS WATER FLOODS)

DROUGHTS

- Lack of continuous records about past occurrences and damages
- No strategic measures for data collection or mitigation
- Data is inonsistent
- Not available in real time
- Lack of quality contol
- Spatial distribution of measurement stations not sufficient

ADRESSING THE PROBLEMS USING REMOTE SENSING

MERIEXWA

Hungary-Serbia

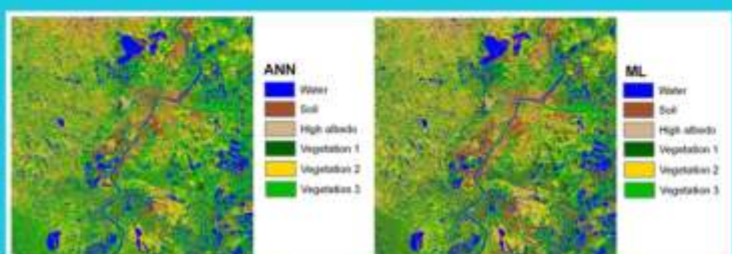
Good neighbours creating common future

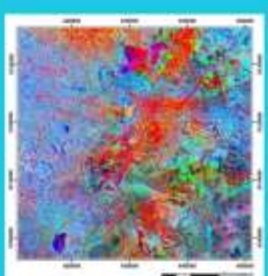
MEASUREMENT, MONITORING, MANAGEMENT AND RISK ASSESSMENT OF INLAND EXCESS WATER IN SOUTH-EAST HUNGARY AND NORTH SERBIA

PARTNER INSTITUTIONS:
University of Szeged, Department of Physical Geography and Geoinformatics
University of Novi Sad, Faculty of Science
University of Novi Sad, Faculty of Technical Science
Duration of the project:2012-2014

METHODS AND RESULTS:

- RapidEye Image analysis





Hungary-Serbia
IPA Cross-border Co-operation Programme

WAHASTRAT

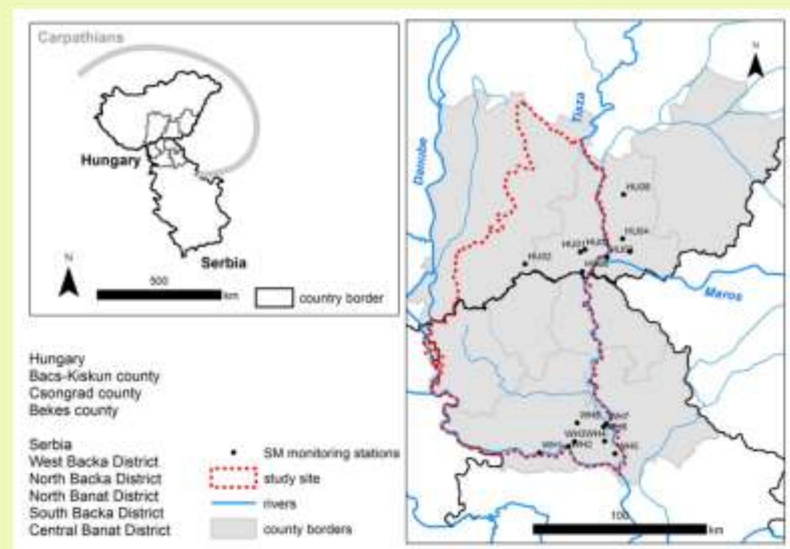
Good neighbours creating common future

WATER SHORTAGE HAZARD AND ADAPTIVE WATER MANAGEMENT STRATEGIES IN THE HUNGARIAN-SERBIAN CROSS-BORDER REGION

PARTNER INSTITUTIONS:
University of Szeged, Department of Physical Geography and Geoinformatics
University of Novi Sad, Faculty of Science
University of Novi Sad, Faculty of Technical Science
Lower Tisza Water Directorate
Duration of the project:2013-2014

METHODS AND RESULTS:

- Soil moisture measurement network



Interreg - IPA CBC
Hungary - Serbia

The project is co-financed by the European Union

PLANNED PROJECT

WATER@RISK

Improvement of drought and excess water monitoring for supporting water management and mitigation of risks related to extreme weather conditions

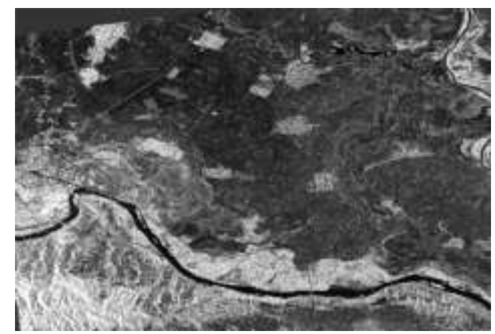
PARTNER INSTITUTIONS:
University of Szeged, Department of Physical Geography and Geoinformatics
University of Novi Sad, Faculty of Science
University of Novi Sad, Faculty of Agriculture
Lower Tisza Water Directorate
Public Water Management Company Vode Vojvodine

DURATION OF THE PROJECT: october 2017 – october 2019

WATER@RISK

✓ CROP AND VEGETATION MONITORING

Multi-spectral, multi temporal remote sensing (SENTINEL 1 & 2) combined with in situ measurements with portable instruments and very high resolution UAV images are applied for mapping phenological and productivity anomalies of different vegetation and crop types in response to extreme water conditions.



PLANNED PROJECT

WATER@RISK

✓ASSESSING IMPACTS OF LAND USE CHANGE AND LAND USE INTENSITY

Landscape metrics based on historical maps, archive and recent satellite and aerial images, regional land cover products and population density changes will be jointly assessed to reveal **how land-use changes and associated pressures influence catchment exposure to drought and excess water hazard**.

Assessment of various satellite band combinations and resolution for crop classification accuracy

MYKOLA MERETSKYI, MYKOLA LAVRENIUK, NATALIIA KUSSUL

Space Research Institute NAS Ukraine and SSA Ukraine

Department of Space Information Technologies and Systems

Project aim:

- ✓ ***demonstration the benefit*** of the Sentinel-2 mission for agriculture across a range of crops and agricultural practices;
- ✓ to ***provide*** the international user community ***with validated algorithms*** and an open source processing system to ***process Sentinel-2*** data in an ***operational way*** for EO products relevant for ***crop monitoring***

Best sensors and bands combination

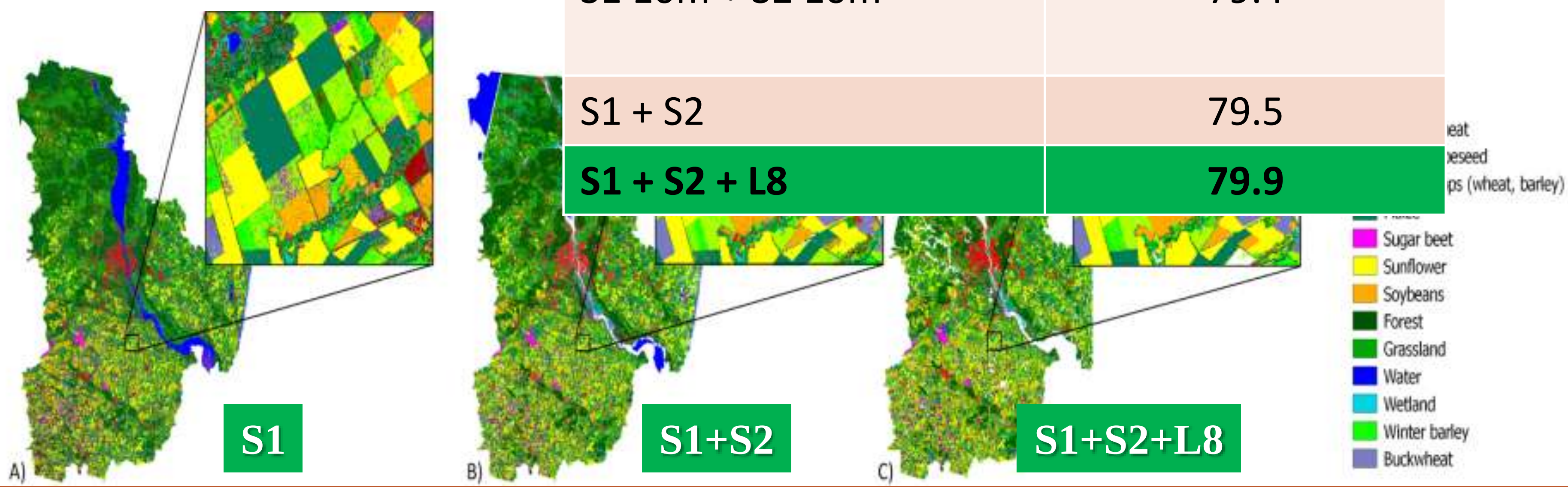
Satellite data:

- ✓ **4** Sentinel-2 scenes
- ✓ **21** Sentinel-1 scenes
- ✓ **2** Landsat-8 scenes

Ground data:

- ✓ **728** ground samples (train and test sets)

Combination	Overall Accuracy, %
S2 + L8	78.6
S2 + L8 without blue bands	76.9
S1 10m	77
S1 10m + S2 10m	79.4
S1 + S2	79.5
S1 + S2 + L8	**79.9**



LANDCOVER CHANGES VS EROSION RATE IN UPPER BREGALNICA CATCHMENT (REPUBLIC OF MACEDONIA)

Ivica Milevski

University Ss. Cyril and Methodius (Republic of Macedonia), Department of Geography. e-mail: ivica@pmf.ukim.mk

Introduction

Soil erosion is one of the greatest environmental and agricultural problems in the Republic of Macedonia (25713 km²; 2,1 million inhabitants). The cause of that are the very suitable natural factors (geology, slopes, climate, land cover), part of them (especially land cover) highly changed by human impact. There are several "hot spot" regions strongly affected with erosion and one of them is the upper part of Bregalnica catchment, upstream of Kalimanci dam (1126,1 km²).

Processes of soil erosion and sediment transport are strongly influenced by land use changes so the modelling of land use changes is important with respect to the simulation of soil degradation and its on-site and off-site consequences (Wang et al., 2012). The results from our research in the upper Bregalnica catchment shows that even relatively minor land use changes had a significant effect on regional soil erosion rates and sediment transport to rivers. Most severe cases are recorded after large forest fires in 2007, when reforested area were burn out and transformed to pastures.

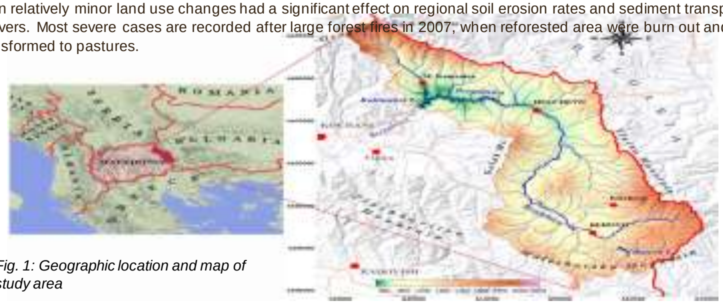


Fig. 1: Geographic location and map of study area

Changes of land cover in upper Bregalnica catchment

Aside from suitable natural factors, very significant influence on soil erosion increase in the catchment have the high human impact on the land cover. Only in the latest century, this area was under deforestation (between the Balkan wars, WWI and WWII), then significant reforestation (between 1960-ties and 1980-ties) accompanied with abandoning of arable land (with migration to the cities), and frequent forest fires in the decades.

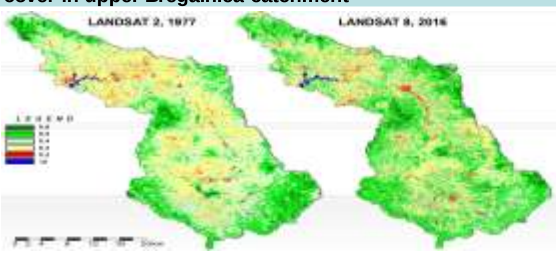


Fig. 2: NDVI change in the catchment between June 1977 and June 2016, calculated from Landsat 2 and Landsat 8 imagery with SAGA GIS v4.1.

The changes are significant even in the last two decades. Comparisons of CLC2000, CLC2006 and CLC2012 (Table 1 and Fig. 3) show that the agricultural (cultivated) area steadily diminished in respect to pastures, forests and other natural vegetation. The main cause is emigration to the cities followed by the abandoning of agricultural land. As the models show, these changes lead to decreased erosion rate in this area.

Table 1. Land cover change from CLC2000, CLC2006 and CLC2012.

	Type	CLC2000	CLC2006	CLC2012	CLC12/00
	Discontinuous urban fabric	0.61	0.73	0.75	0.14
	Dump sites	0.07	0.08	0.07	0.01
	Non-irrigated arable land	1.86	1.88	1.81	-0.05
	Rice fields	0.04	0.00	0.00	-0.04
	Vineyards	0.02	0.02	0.02	0.00
	Fruit trees, berry plantations	0.56	0.59	0.58	0.02
	Pastures	8.63	9.32	9.13	0.50
	Annual crops with per. crops	14.36	13.28	12.70	-1.66
	Complex cultivation patterns	17.54	15.87	16.38	-1.17
	Agro-forestry areas	22.36	21.29	20.76	-1.59
	Broad-leaved forest	10.35	10.74	10.45	0.11
	Coniferous forest	5.44	5.76	6.29	0.85
	Mixed forest	4.85	4.90	5.12	0.27
	Sclerophyllous vegetation	12.92	15.18	15.61	2.69
	Water courses	0.38	0.38	0.32	-0.06

Fig. 3: CLC comparisons of the upper Bregalnica catchment between 2000 and 2012. The most noticeable change is inside the black rectangle where coniferous forests are transformed in pastures after the forest fires in 2007.

Correlation of land cover change and erosion rate

As the land cover is very important factor for soil erosion, it is included in the most (empirical) models of erosion rate assessment. In Macedonia, as well as in other countries in the region, the estimation of average soil erosion potential and sediment yield is generally achieved with Erosion Potential Model (EPM, Gavrilović 1972). The model is in form: $Wy = T \cdot H \cdot 3.14 \cdot sqrtZ^3 \cdot f$, where: W is average annual soil erosion in m³; T is temperature coefficient in form: $T = (0.1 \cdot t + 0.1)0.5$, where t is mean annual air temperature; H is mean annual precipitation in mm; Z is erosion coefficient ranging from 0.1 to 1.5 and over; and f is study area in km². GIS-calibrated coefficient Z is calculated from the equation: $Z=sqrt(Y)*\varphi*((X*a+\varphi)*log(a+1)+sqrt(a/57.3))$, where Y is soil/rock erodibility, $X*a$ is land cover index (from CLC or satellite imagery) and φ is index of visible erosion processes (from the red band of Landsat imagery);(Milevski, 2015).

According to the GIS-based model, coefficient Z (erosion risk) significantly decreased between 1977 and 2016 (from 0.54 to 0.43; *Fig. 6*). Also, the average soil erosion rate of about 925 m³/km²/y in 1977, decreased to 725 m³/km²/y in 2016, which is still very high value (0.72 mm/y). To note that these results are confirmed by measurement of the deposition in the Kalimanci reservoir.

However, aside of general trend in the catchment, there are even some smaller areas with increased erosion, especially

Fig. 4: Map of the potential erosion rate in the upper Bregalnica catchment for 1977, 2000 and 2016 (the model uses only average yearly sum of precipitation and temperatures).

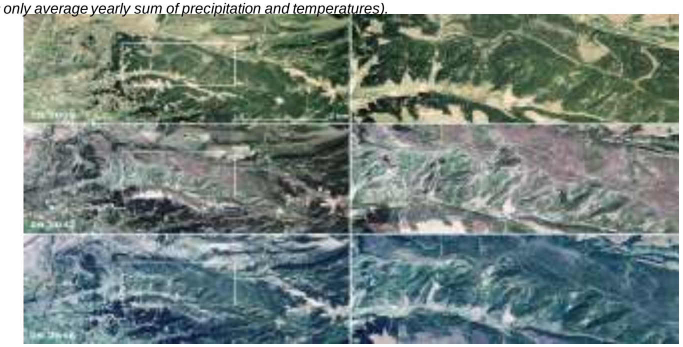


Fig. 5: Short-term land cover changes in the study area as a result of forest fires followed by partial reforestation and revegetation. From GE Professional historical imagery approach. 10.06.2017.

Conclusion

The results show that the erosion rate in the upper Bregalnica catchment is highly dependent on land cover. As dense is the vegetation, erosion rate decrease and vice-versa. However, the relation is not so simple as the models indicate. Aside from relatively "static" factors like topography (altitude, slopes, aspects), there is a strong influence of changing climate mostly through precipitation regime with frequent occurrence of heavy rains. Also, in the latest decades, numerous hot waves were recorded, which are correlated with increased forest fire occurrences (2000, 2007, 2012). Furthermore, census data shows dramatic decline of local rural population, especially in "active age". ...or acceptable erosion assessment, land ...LCC) must be calculated and scaled with ...n Europe, one of the best sources of land ... is Corine Land Cover (starting from 1990 or ...ually there are some inaccuracies of land ...ses in CLC2000 and CLC2006 that have been ...r the area of Macedonia, and which must be ...account (or corrected with Landsat). Earlier ...after 1970-ties) can be ... Landsat MSS/TM).

Fig. 6: Change of land cover vs erosion rate (coeff. Z) in the upper Bregalnica catchment between 1977 and 2016.

Bibliography

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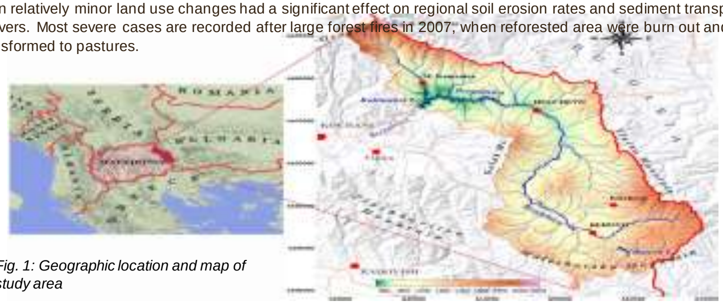

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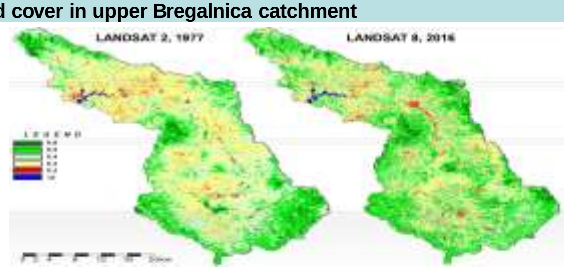

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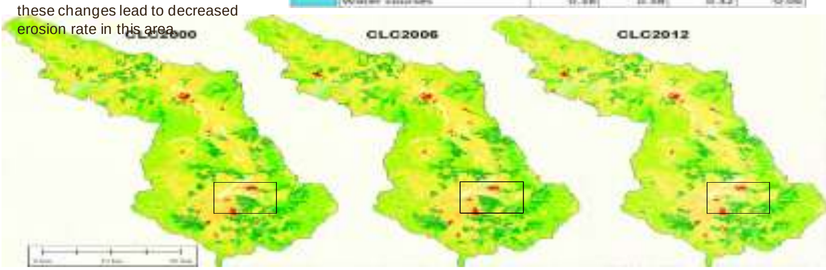

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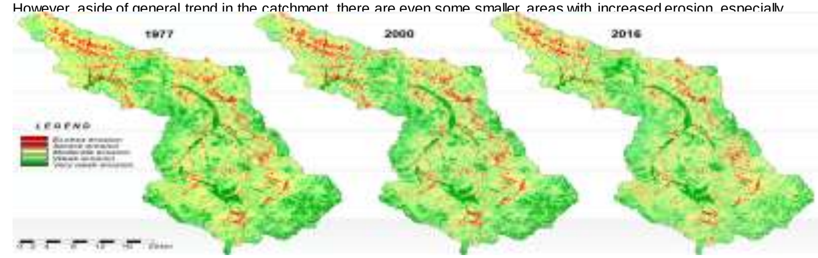

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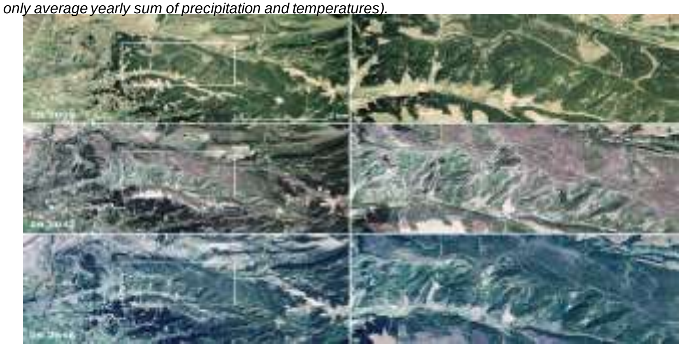

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University Ss. Cyril and Methodius (Republic of Macedonia), Department of Geography. e-mail: ivica@pmf.ukim.mk

Introduction

Soil erosion is one of the greatest environmental and agricultural problems in the Republic of Macedonia (25713 km^2; 2,1 million inhabitants). The cause of that are the very suitable natural factors (geology, slopes, climate, land cover), part of them (especially land cover) highly changed by human impact. There are several “hot spot” regions strongly affected with erosion and one of them is the upper part of Bregalnica catchment, upstream of Kalimanci dam (1126,1 km^2).

Processes of soil erosion and sediment transport are strongly influenced by land use changes so the modelling of land use changes is important with respect to the simulation of soil degradation and its on-site and off-site consequences (Wang et al., 2012). The results from our research in the upper Bregalnica catchment shows that even relatively minor land use changes had a significant effect on regional soil erosion rates and sediment transport to rivers. Most severe cases are recorded after large forest fires in 2007, when reforested area were burn out and transformed to pastures.

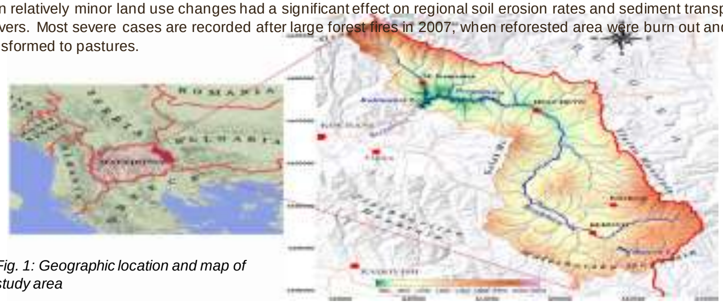

Fig. 1: Geographic location and map of study area

Changes of land cover in upper Bregalnica catchment

Aside from suitable natural factors, very significant influence on soil erosion increase in the catchment have the high human impact on the land cover. Only in the latest century, this area was under deforestation (between the Balkan wars, WWI and WWII), then significant reforestation (between 1960-ties and 1980-ties) accompanied with abandoning of arable land (with migration to the cities), and fre[illegible] de[illegible]

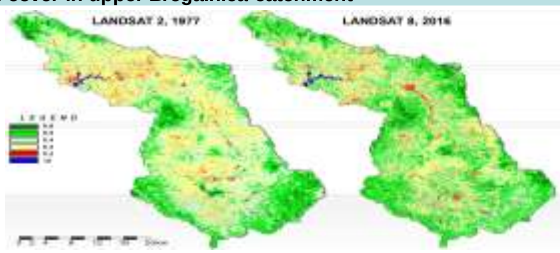

Fig. 2: NDVI change in the catchment between June 1977 and June 2016, calculated from Landsat 2 and Landsat 8 imagery with SAGA GIS v4.1.

The changes are significant even in the last two decades. Comparisons of CLC2000, CLC2006 and CLC2012 (Table 1 and Fig. 3) show that the agricultural (cultivated) area steadily diminished in respect to pastures, forests and other natural vegetation. The main cause is emigration to the cities followed by the abandoning of agricultural land. As the models show, these changes lead to decreased erosion rate in this area.

Table 1. Land cover change from CLC2000, CLC2006 and CLC2012.

	[illegible]	[illegible]	[illegible]	CLC2012	CLC12/00
	Discontinuous urban fabric	0.61	0.73	0.75	0.14
	Dump sites	0.07	0.08	0.07	0.01
	Non-irrigated arable land	1.86	1.88	1.81	-0.06
	Rice fields	0.04	0.00	0.00	-0.04
	Vineyards	0.02	0.02	0.02	0.00
	Fruit trees, berry plantations	0.56	0.59	0.58	0.02
	Pastures	8.63	9.32	9.13	0.50
	Annual crops with per. crops	14.36	13.28	12.70	-1.66
	Complex cultivation patterns	17.54	15.87	16.38	-1.17
	Agro-forestry areas	22.36	21.29	20.76	-1.59
	Broad-leaved forest	10.35	10.74	10.45	0.11
	Coniferous forest	5.44	5.76	6.29	0.85
	Mixed forest	4.85	4.90	5.12	0.27
	Sclerophyllous vegetation	12.92	15.18	15.61	2.69
	Water courses	0.38	0.38	0.32	-0.06

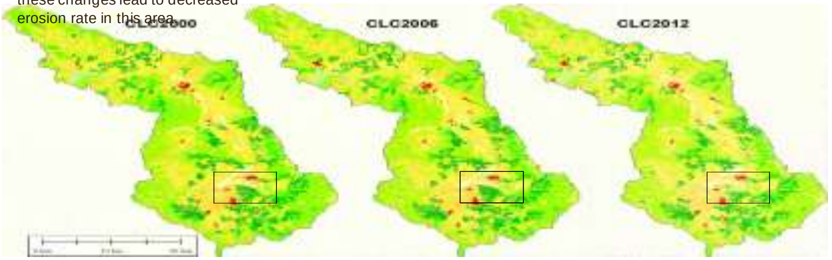

Fig. 3: CLC comparisons of the upper Bregalnica catchment between 2000 and 2012. The most noticeable change is inside the black rectangle where coniferous forests are transformed in pastures after the forest fires in 2007.

Correlation of land cover change and erosion rate

As the land cover is very important factor for soil erosion, it is included in the most (empirical) models of erosion rate assessment. In Macedonia, as well as in other countries in the region, the estimation of average soil erosion potential and sediment yield is generally achieved with Erosion Potential Model (EPM, Gavrilović 1972). The model is in form: $Wy = T \cdot H \cdot 3.14 \cdot sqrtZ^3 \cdot f$, where: W is average annual soil erosion in m^3; T is temperature coefficient in form: $T = (0.1 \cdot t + 0.1)0.5$, where t is mean annual air temperature; H is mean annual precipitation in mm; Z is erosion coefficient ranging from 0.1 to 1.5 and over; and f is study area in km^2. GIS-calibrated coefficient Z is calculated from the equation: $Z=sqrt(Y)*\varphi*((X*a+\varphi)*log(a+1)+sqrt(a/57.3))$, where Y is soil/rock erodibility, $X*a$ is land cover index (from CLC or satellite imagery) and φ is index of visible erosion processes (from the red band of Landsat imagery);(Milevski, 2015).

According to the GIS-based model, coefficient Z (erosion risk) significantly decreased between 1977 and 2016 (from 0.54 to 0.43; *Fig. 6*). Also, the average soil erosion rate of about 925 $m^3/km^2/y$ in 1977, decreased to 725 $m^3/km^2/y$ in 2016, which is still very high value (0.72 mm/y). To note that these results are confirmed by measurement of the deposition in the Kalimanci reservoir.

However, aside of general trend in the catchment, there are even some smaller areas with increased erosion, especially

Fig. 4: Map of the potential erosion rate in the upper Bregalnica catchment for 1977, 2000 and 2016 (the model uses only average yearly sum of precipitation and temperatures).

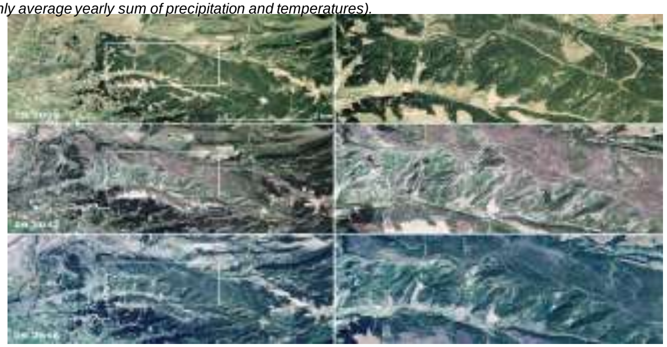

Fig. 5: Short-term land cover changes in the study area as a result of forest fires followed by partial reforestation and revegetation. From GE Professional historical imagery, approach. 10.06.2017.

Conclusion

The results show that the erosion rate in the upper Bregalnica catchment is highly dependent on land cover. As dense is the vegetation, erosion rate decrease and vice-versa. However, the relation is not so simple as the models indicate. Aside from relatively “static” factors like topography (altitude, slopes, aspects), there is a strong influence of changing climate mostly through precipitation regime with frequent occurrence of heavy rains. Also, in the latest decades, numerous hot waves were recorded, which are correlated with increased forest fire occurrences (2000, 2007, 2012). Furthermore, census data shows dramatic decline of local rural population, especially in “active age”. [...]or acceptable erosion assessment, land [...] LCC) must be calculated and scaled with [...]n Europe, one of the best sources of land [...] is Corine Land Cover (starting from 1990 or [...]ually there are some inaccuracies of land [...]ses in CLC2000 and CLC2006 that have been [...]or the area of Macedonia, and which must be [...]account (or corrected with Landsat). Earlier [...]after 1970-ties) can be at 1:5 (MSS/TM).

Fig. 6: Change of land cover vs erosion rate (coeff. Z) in the upper Bregalnica catchment between 1977 and 2016.

Bibliography

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LANDCOVER CHANGES VS EROSION RATE IN UPPER BREGALNICA CATCHMENT (REPUBLIC OF MACEDONIA)

Ivica Milevski

University Ss. Cyril and Methodius (Republic of Macedonia), Department of Geography. e-mail: ivica@pmf.ukim.mk

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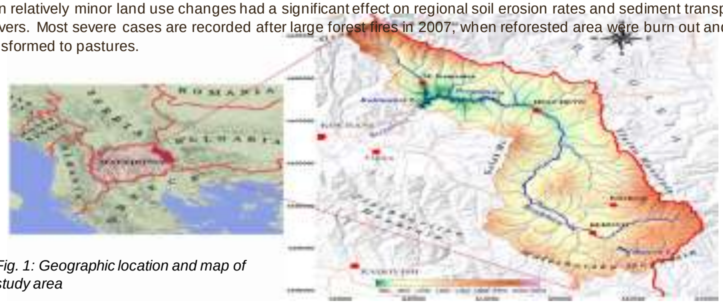

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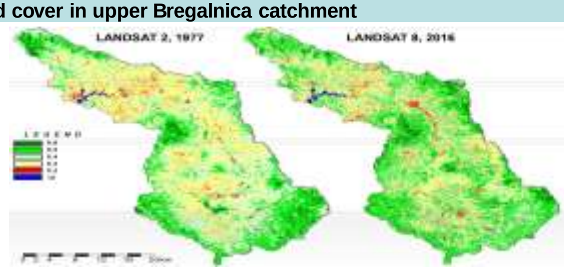

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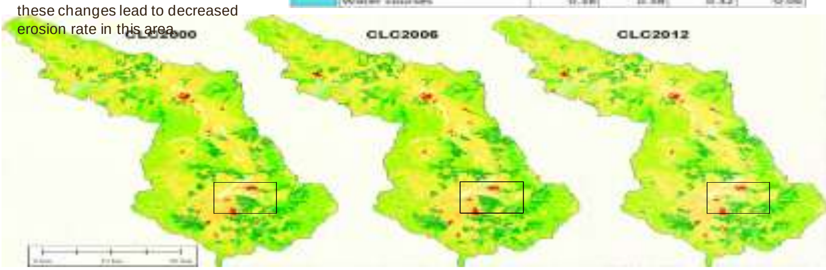

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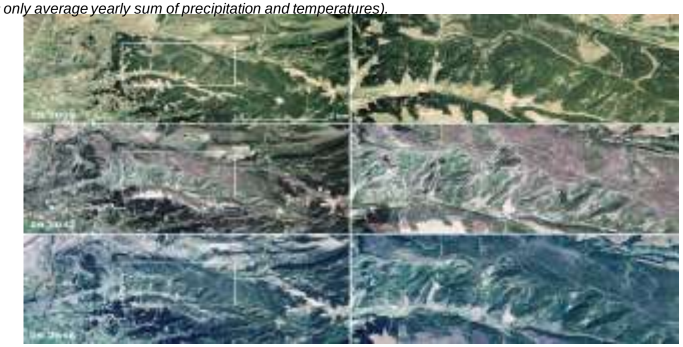

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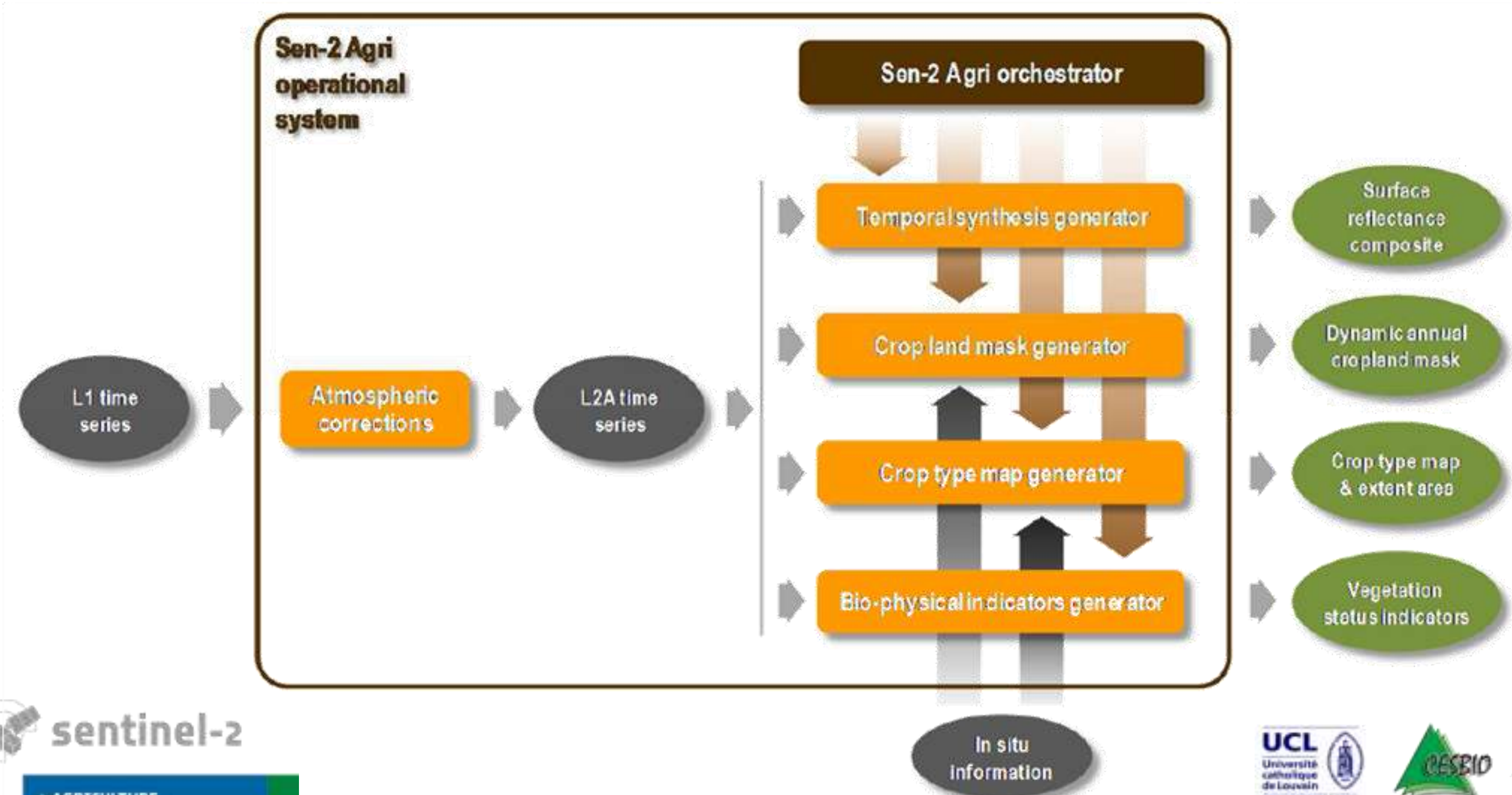
SENTINEL-2 FOR AGRICULTURE (Sen2agri) – Brice Mora

esa

- Project stems from user consultations organised by ESA in 2012-2014
- Flexible algorithm to adapt to different croplands
- A system designed to run in an automated near real time (and off line) mode to deliver agricultural products as satellite images are ingested



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Demonstration at National and Local Levels
Brice More

Sen2agri Project

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Supported by: Croatian scientific foundation

Hrvatska zaklada za znanost

Vegetation detection using video data

Luka Rumora[(1)], Mario Miler[(1)], Damir Medak[(1)],
Ivan Majić[(2)], Ivan Pilaš[(3)]
(1) University of Zagreb, Faculty of Geodesy
(2) Department of Infrastructure Engineering, The University of Melbourne
(2) Croatian Forest Research Institute, Jastrebarsko

SCERIN-5 Capacity Building Workshop (CBW)
Pecs, Slovakia 19-23 June, 2017

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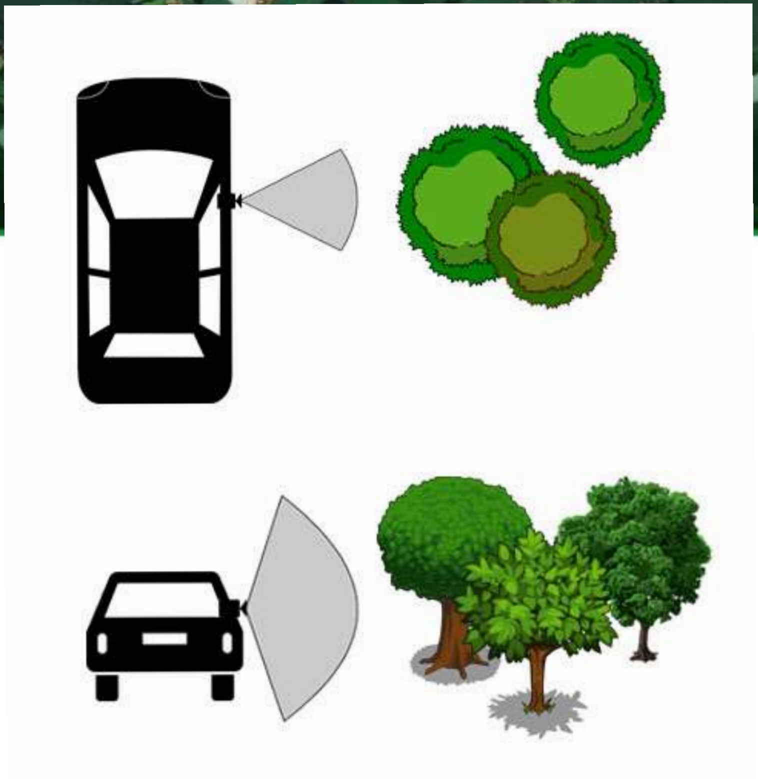

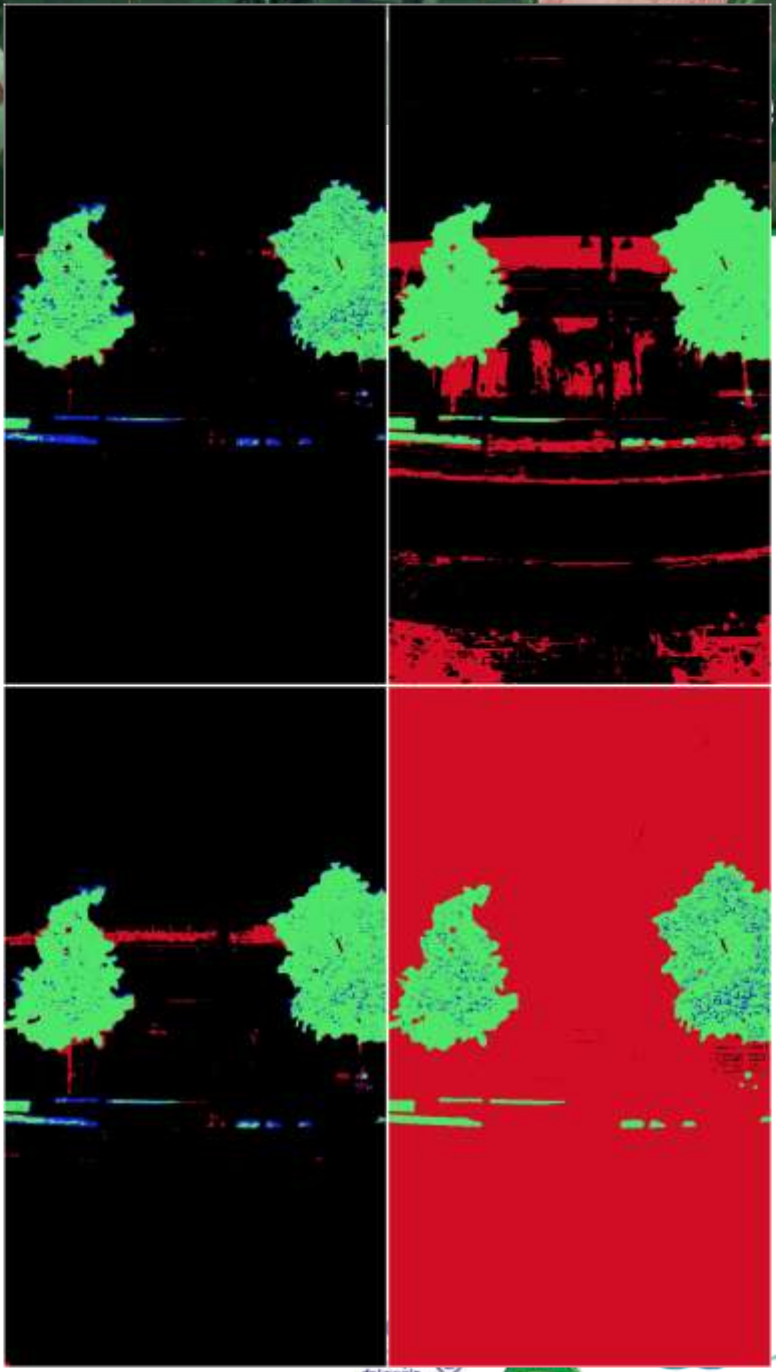

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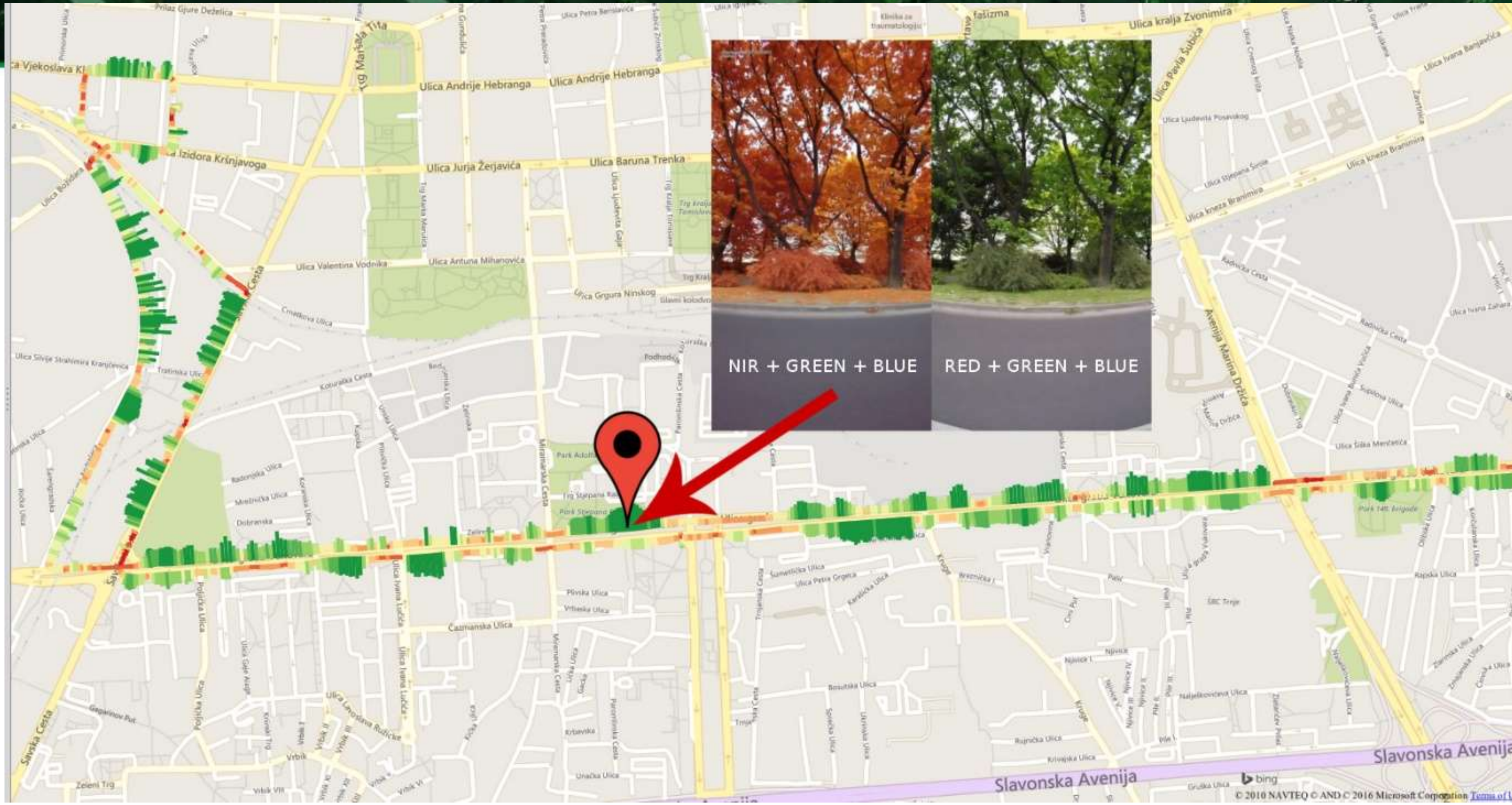

Vegetation map

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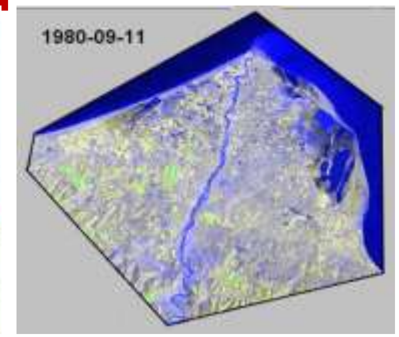
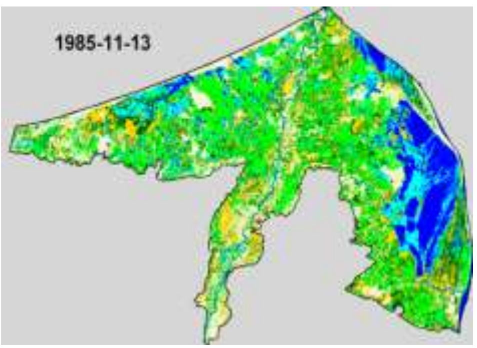
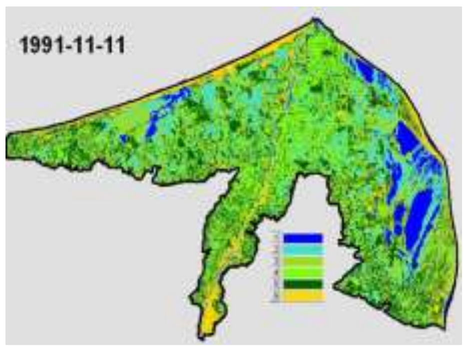
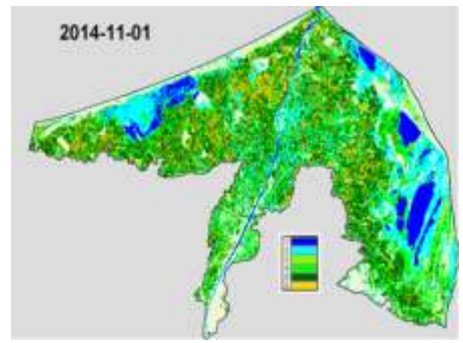
Vladimir Starodubtsev

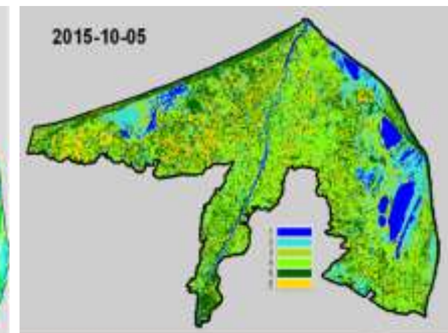
Land cover change in river deltas under anthropogenic pressure





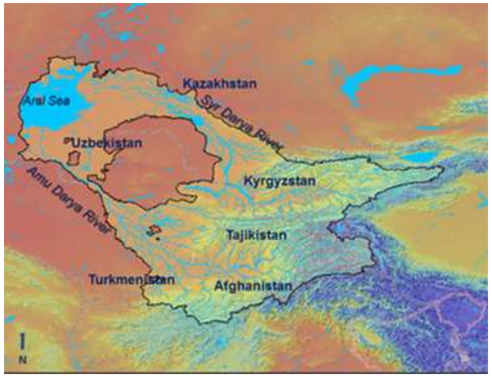


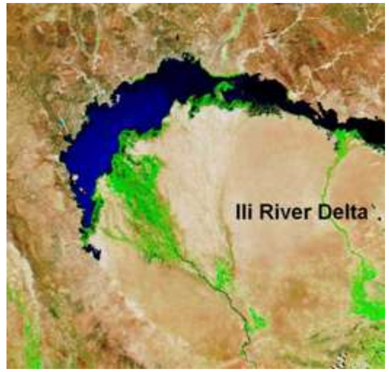


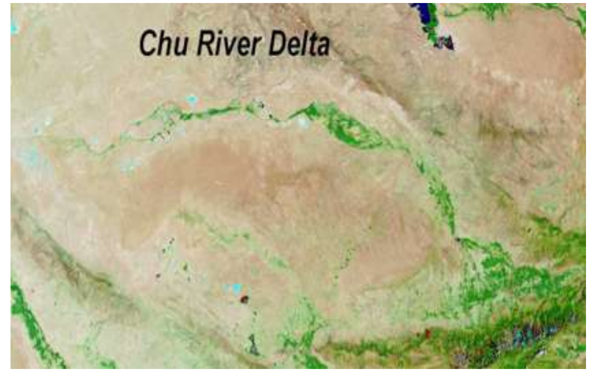


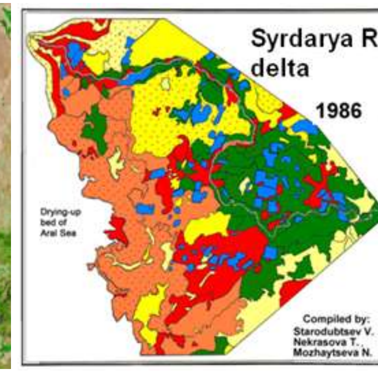
Land	1985.11.13	2014.08.31	2015.10.05
Water area	5566	3617	3248
Swamp land	6317	8440	7814
Wet meadow	14516	11995	11835
Arable, grassland, forest	25379	27725	28880
Total, ha	51778	51777	51777

Recommended for future study: Land cover change in deltas of Central Asia and Caspian basin

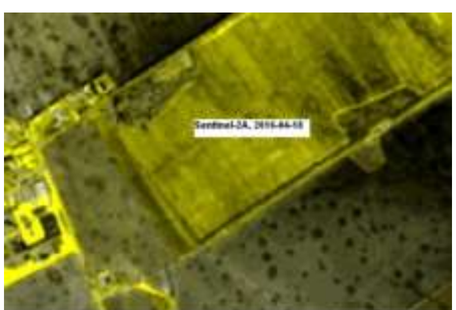


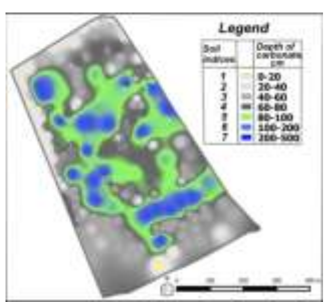


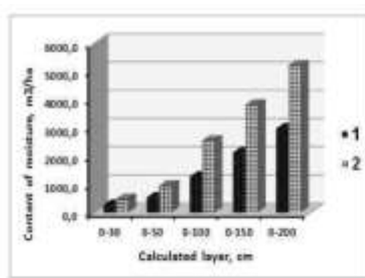


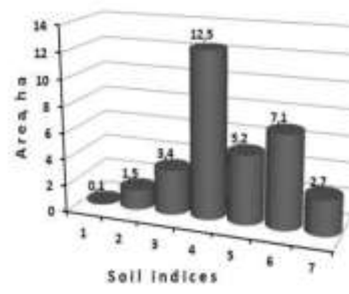


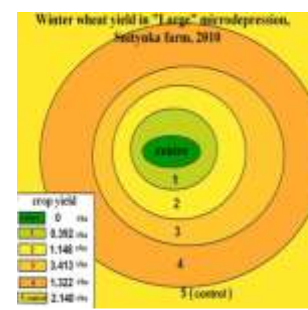
2. Soil cover heterogeneity, it environmental & economic significance











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

Jan Feranec[1], Tomas Soukup[2], Gregory N. Taff [3], Premysl Stych[4], Ivan Bicik[5]

1 Slovak Academy of Sciences, Institute of Geography; feranec@savba.sk;

2 Gurudeva Institute of Science and Technology; tomas.soukup@gisat.cz;

3 Norwegian Institute of Bioeconomy Research; gregory.taff@nibio.no;

4 Charles University in Prague, Department of Applied Geoinformatics and Cartography; stych@natur.cuni.cz;

5 Charles University in Prague, Department of Social Geography and Regional Development; bicik@natur.cuni.cz

Objectives

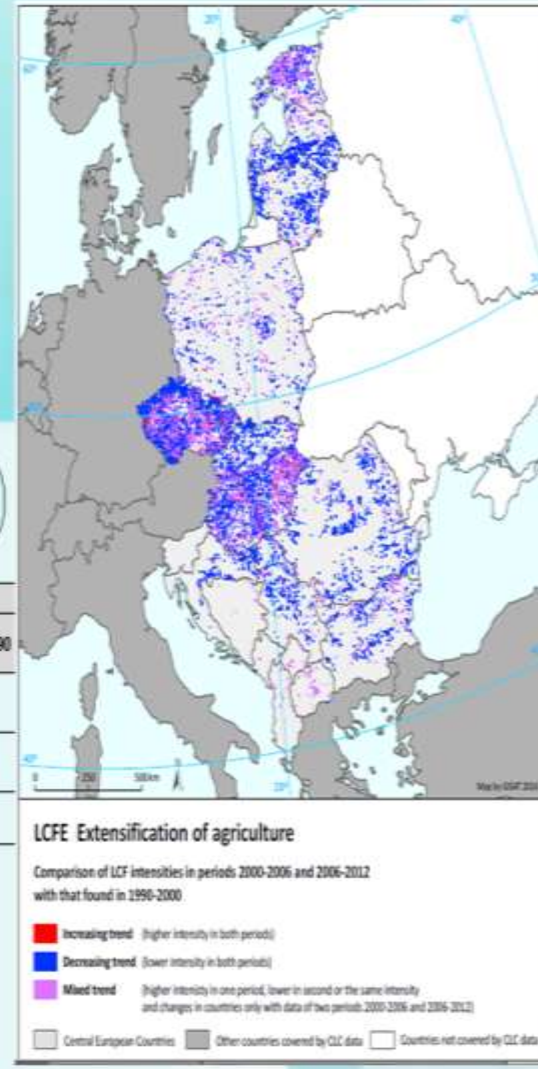
The CORINE CLC datasets of 1990, 2000, 2006, 2012 and changes 1990-2000, 2000-2006 and 2006-2012 offer the opportunity to observe the European landscape dynamics. This poster presents a trend of land use land cover changes (LUCC) and its spatial distribution and intensity in Central and Eastern Europe during the periods 1990-2012.

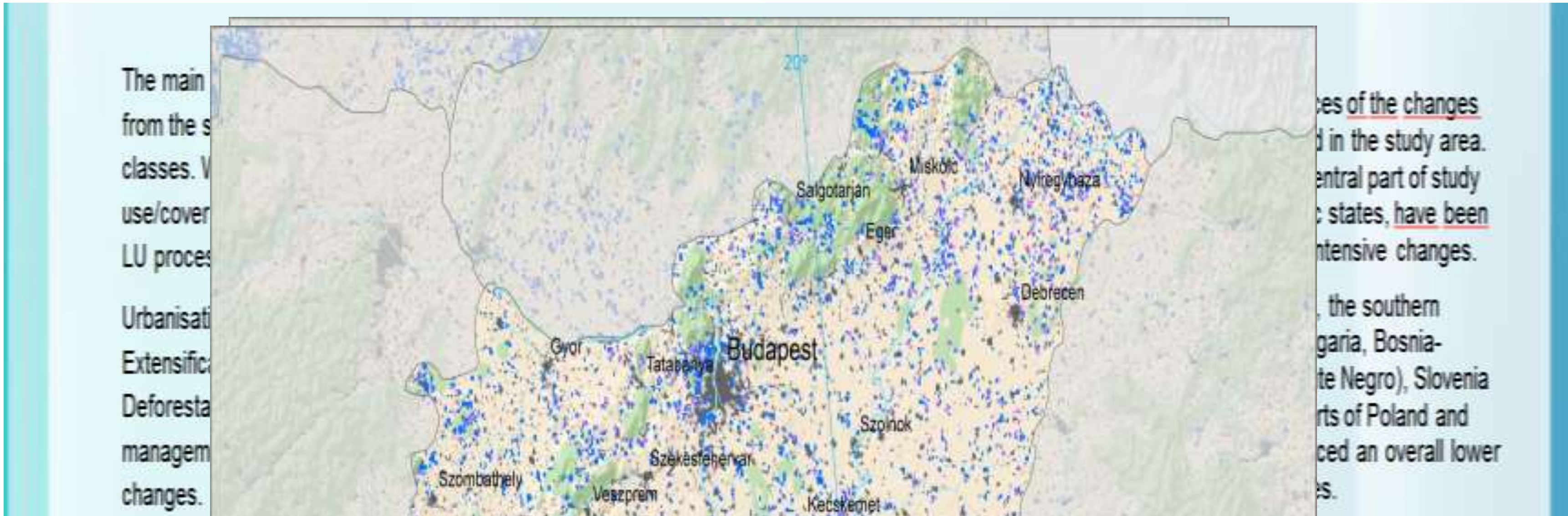
Macro-scale map presentation using the CLC data enables an to identify the main types of landscape changes.

Results

Type of change	Changes 1990 - 2000		Changes 2000 - 2006		Changes 2006 - 2012		
	(in km²)	(in km²/year*)	(in km²)	(in km²/year)	(in km²)	(in km²/year)	1990
Intensification of agriculture	3 822,12	583,03	1 055,17	175,87	1 381,51	230,25	
Extensification of agriculture	6 365,74	847,13	1 055,52	175,92	1 945,22	324,21	
Total	10 187,86	1430,16	2 110,69	351,79	3 326,73	554,46	

The results show that significant changes occurred on agricultural lands in the study region. The most intensive LUCC in the first period 1990-2000, decreased in the second period and restart intensity after 2006.





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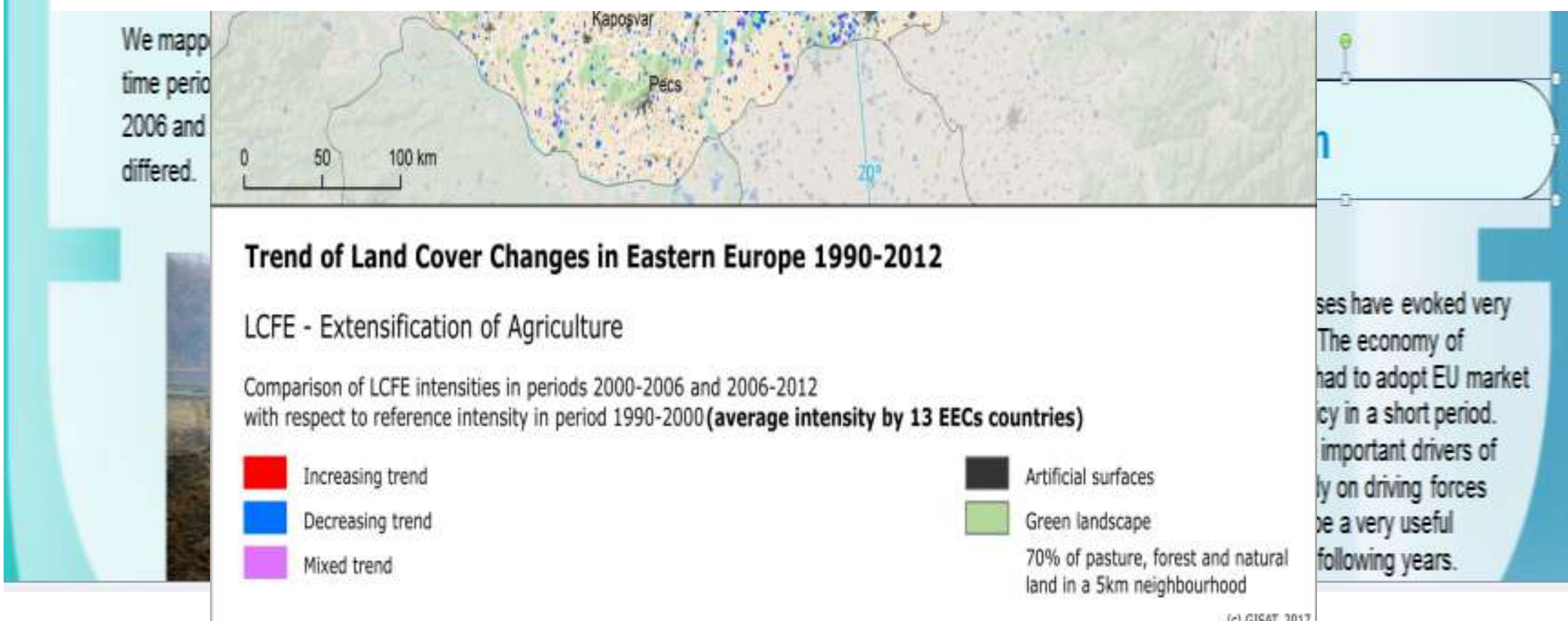
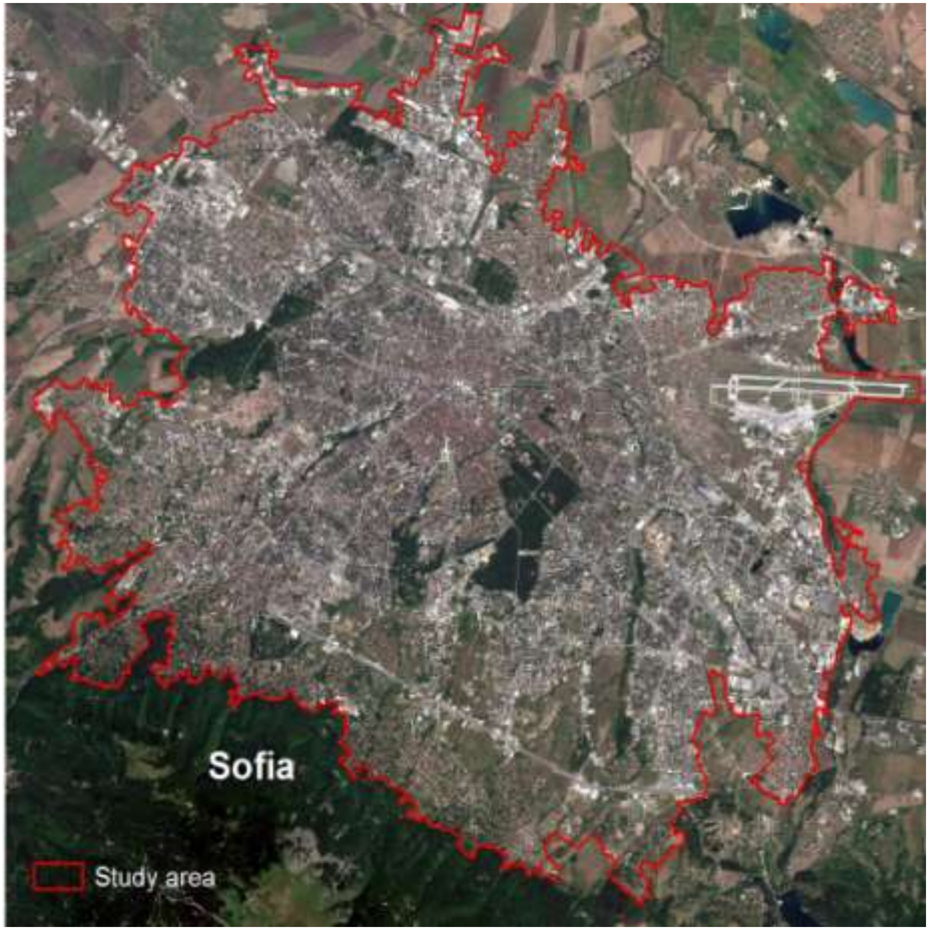


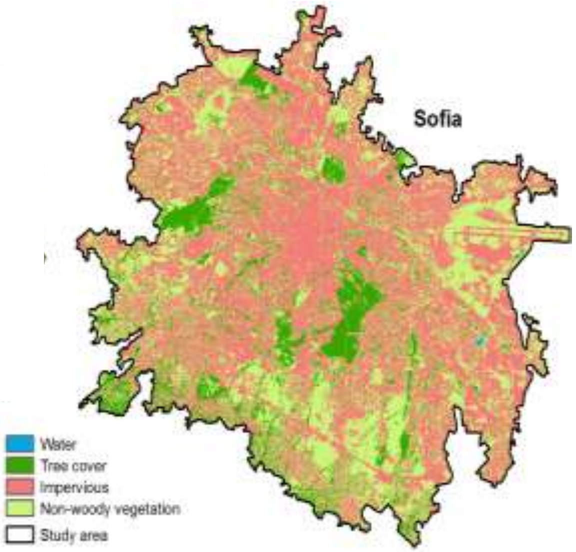
SCERIN-5, Pecs, Hungary, June 20-23, 2017

Mapping urban green spaces based on Sentinel-2A satellite imagery

Rumiana Vatseva
National Institute of Geophysics, Geodesy and Geography - Bulgarian Academy of Sciences

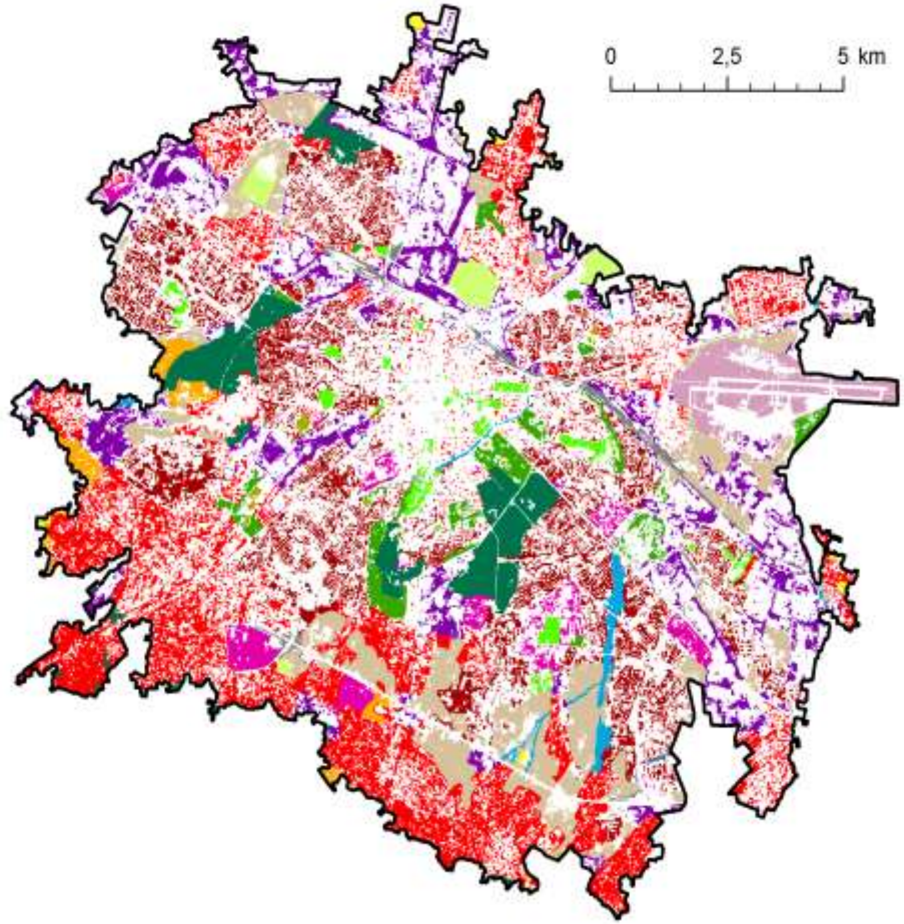
- to investigate and map the spatial distribution of urban green spaces (UGS) in Sofia, Bulgaria using *Sentinel-2A (S2A)* satellite image (acquired 28th August 2015) by implementing various *spatial analysis techniques*.
- S2A is downloaded from Copernicus Sentinels Scientific Data Hub (https://scihub.copernicus.eu/dhus/).
- The image is orthorectified and radiometrically corrected (processing level 1C).
- The S2A data processing and classification were performed using ESA SNAP 3.0 & ESRI ArcGIS 10.3.





Methods

1. Automatic land cover classification and extraction of UGS polygons
2. Manual classification of UGS polygons - 15 classes:
   1. Urban forest
   2. Cultivated park
   ....
   15. Ruderal vegetation



Quantitative and qualitative estimation of UGS

UGS Class	Class area (ha)	Tree cover area (ha)	Tree cover percentage (%)	Class abundance (%)
1	706.33	614.15	86.9	7.8
2	316.55	152.53	48.2	3.5
3	155.87	79.76	51.2	1.7
4	166.45	35.39	21.3	1.8
5	125.56	73.20	58.3	1.4
6	1716.08	388.56	22.6	19.1
7	2424.41	651.35	26.9	26.9
8	292.07	101.34	34.7	3.2