Research Infrustructure and Capabilities for EO based Forest, Landscape and Ecosystem Research in Slovakia

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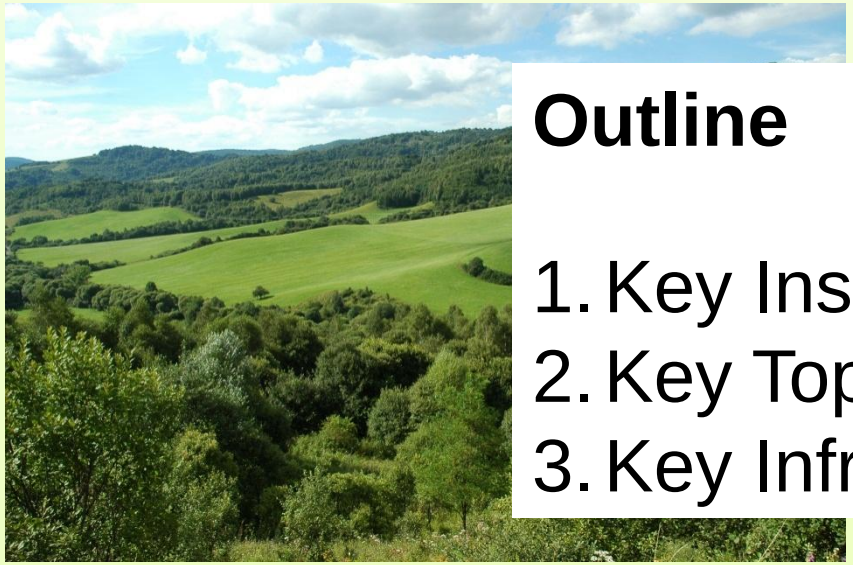
Slovak Academy of Sciences



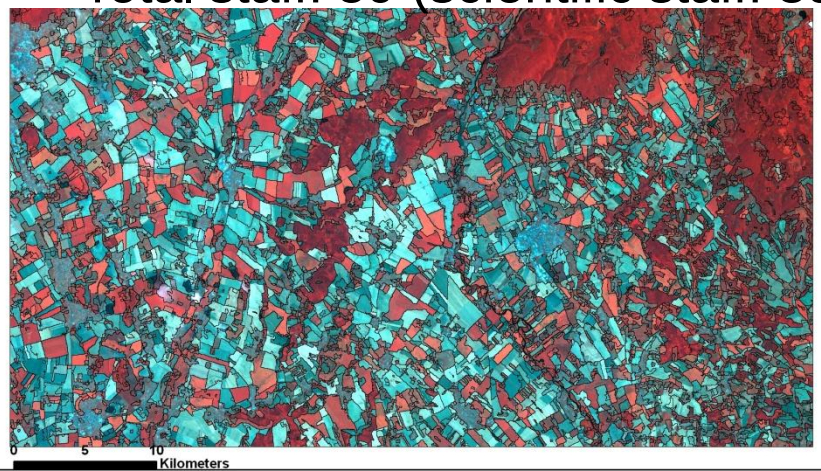
Outline

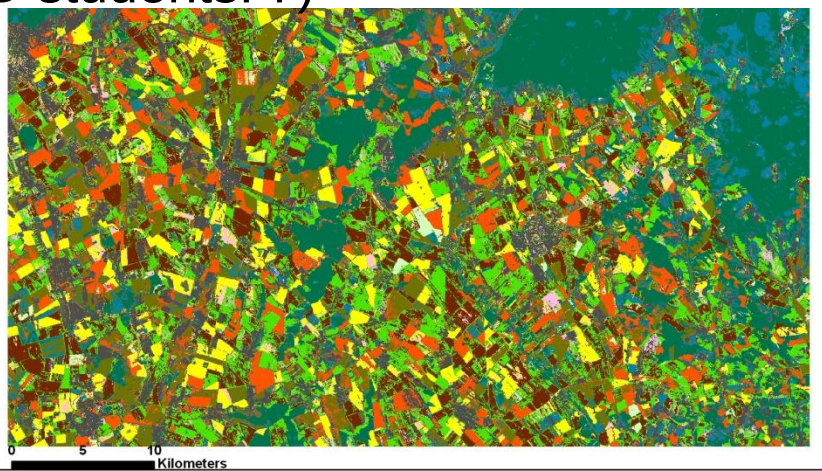
1. Key Institutions
2. Key Topics
3. Key Infrastructure

Landscape and Ecosystem Research

Institute of Landscape Ecology
Slovak Academy of Sciences

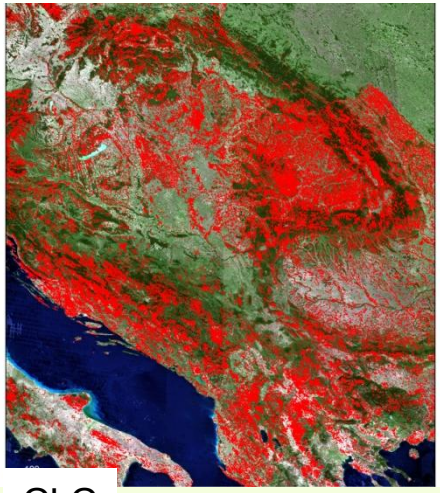
- **Interdisciplinary scientific institution for basic and applied research in landscape and ecosystem research (established in 1965)**
- Total staff: 59 (scientific staff: 39; PhD students: 7)





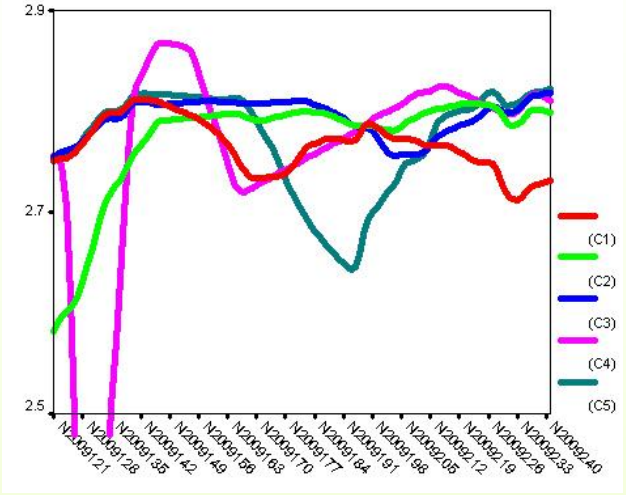
MODIS based analysis of NDVI time series

1. Grassland mapping

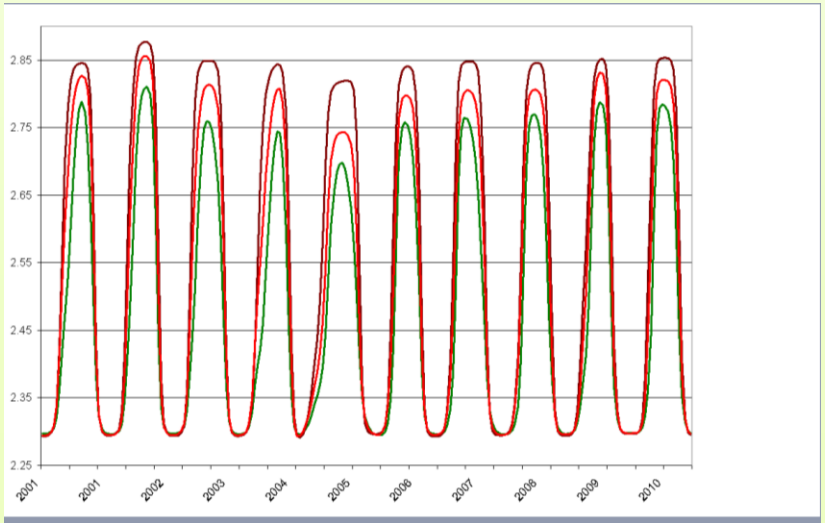


CLC

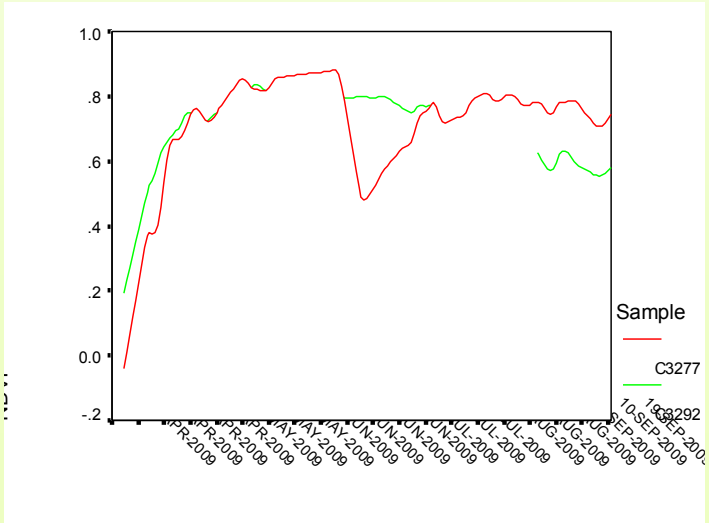
2. Grassland habitat classification



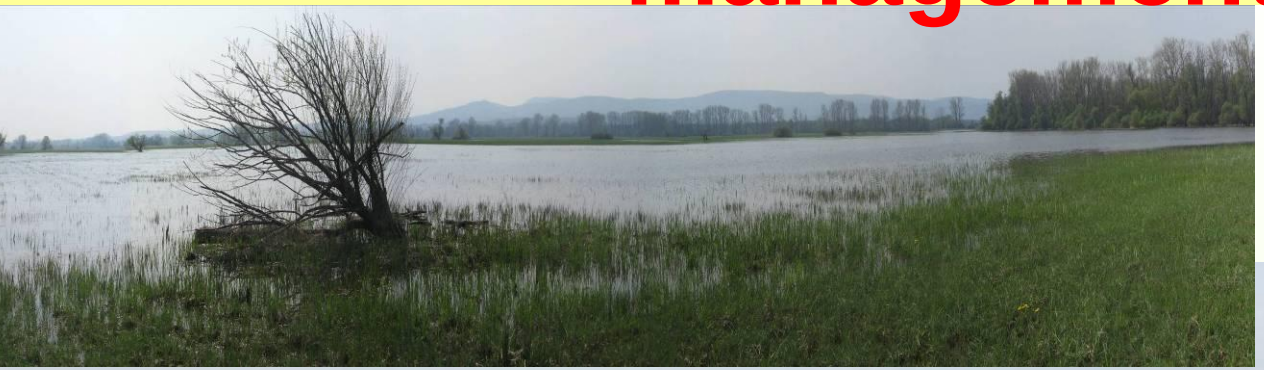
3. Grassland LSP



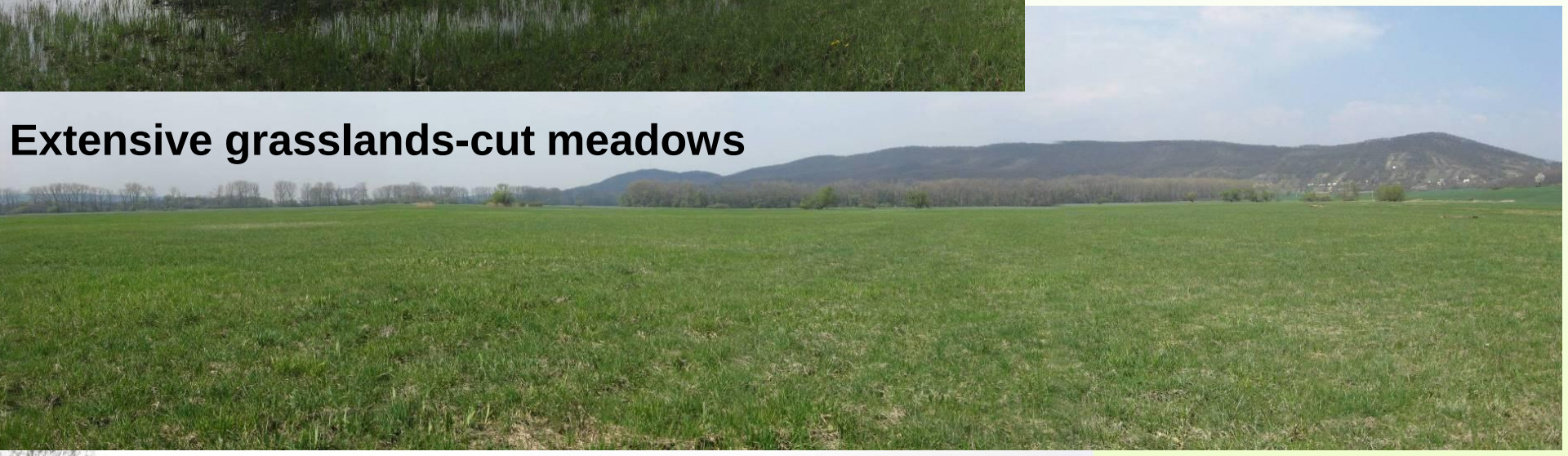
4. Detection of management practices



3. Detection of grassland management



Alluvial flooded meadows

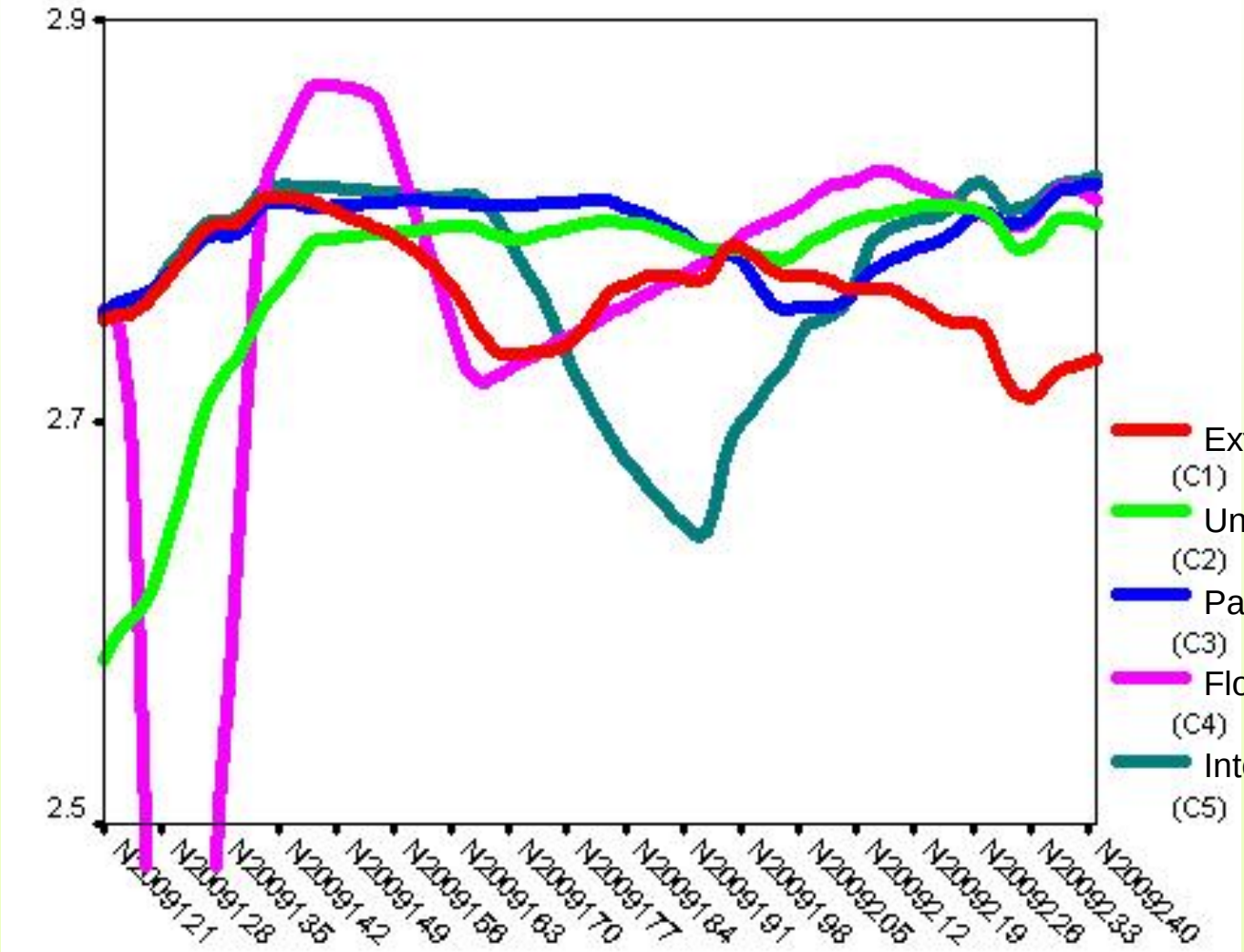


Extensive grasslands-cut meadows

Intensive grasslands-pastures

Classification of BHC grasslands

- Based on within season trajectory of NDVI

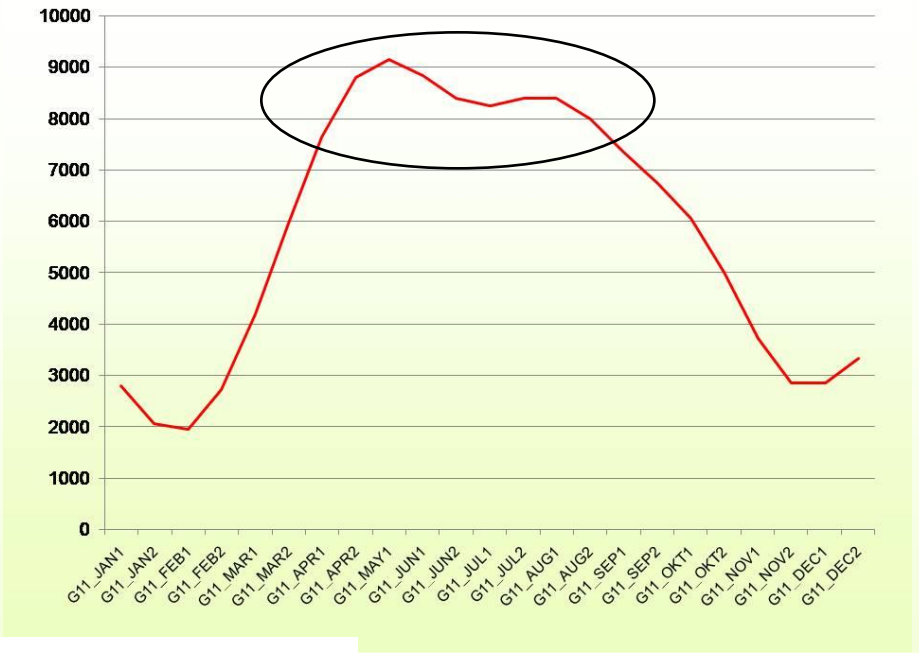


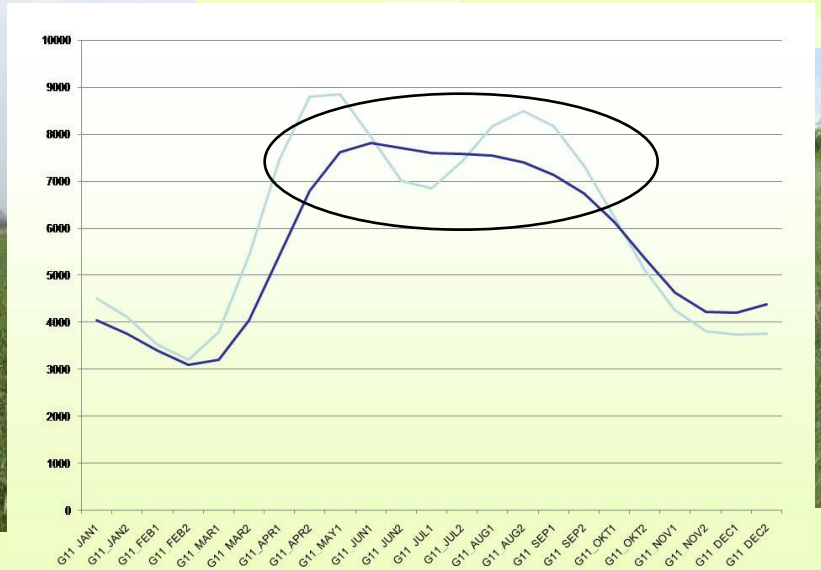
Intensive grasslands

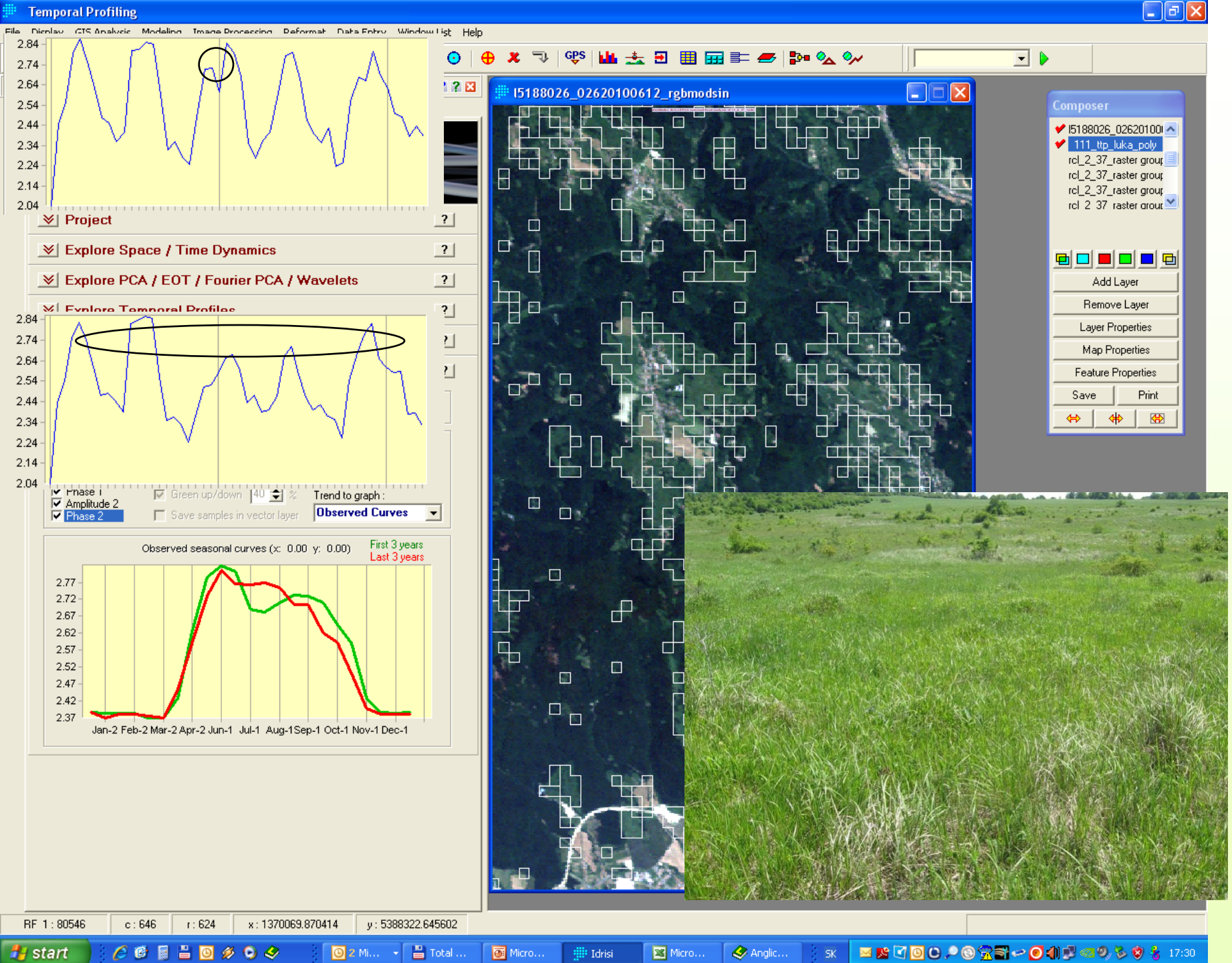
unmanaged - abandoned

flooded grasslands

Cutting of hay meadows






Temporal Profiling
File Display GIS Analysis Modeling Image Processing Reformat Data Entry Window List Help
2.84 2.74 2.64 2.54 2.44 2.34 2.24 2.14 2.04
Project
Explore Space / Time Dynamics
Explore PCA / EOT / Fourier PCA / Wavelets
Explore Temporal Profiles
Phase 1
Amplitude 2
Phase 2
Green up/down
40
%
Save samples in vector layer
Trend to graph :
Observed Curves
Observed seasonal curves (x: 0.00 y: 0.00)
First 3 years
Last 3 years
2.77 2.72 2.67 2.62 2.57 2.52 2.47 2.42 2.37
Jan-2 Feb-2 Mar-2 Apr-2 Jun-1 Jul-1 Aug-1 Sep-1 Oct-1 Nov-1 Dec-1
l5188026_02620100612_rgbmodsin
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rcl_2_37_raster group
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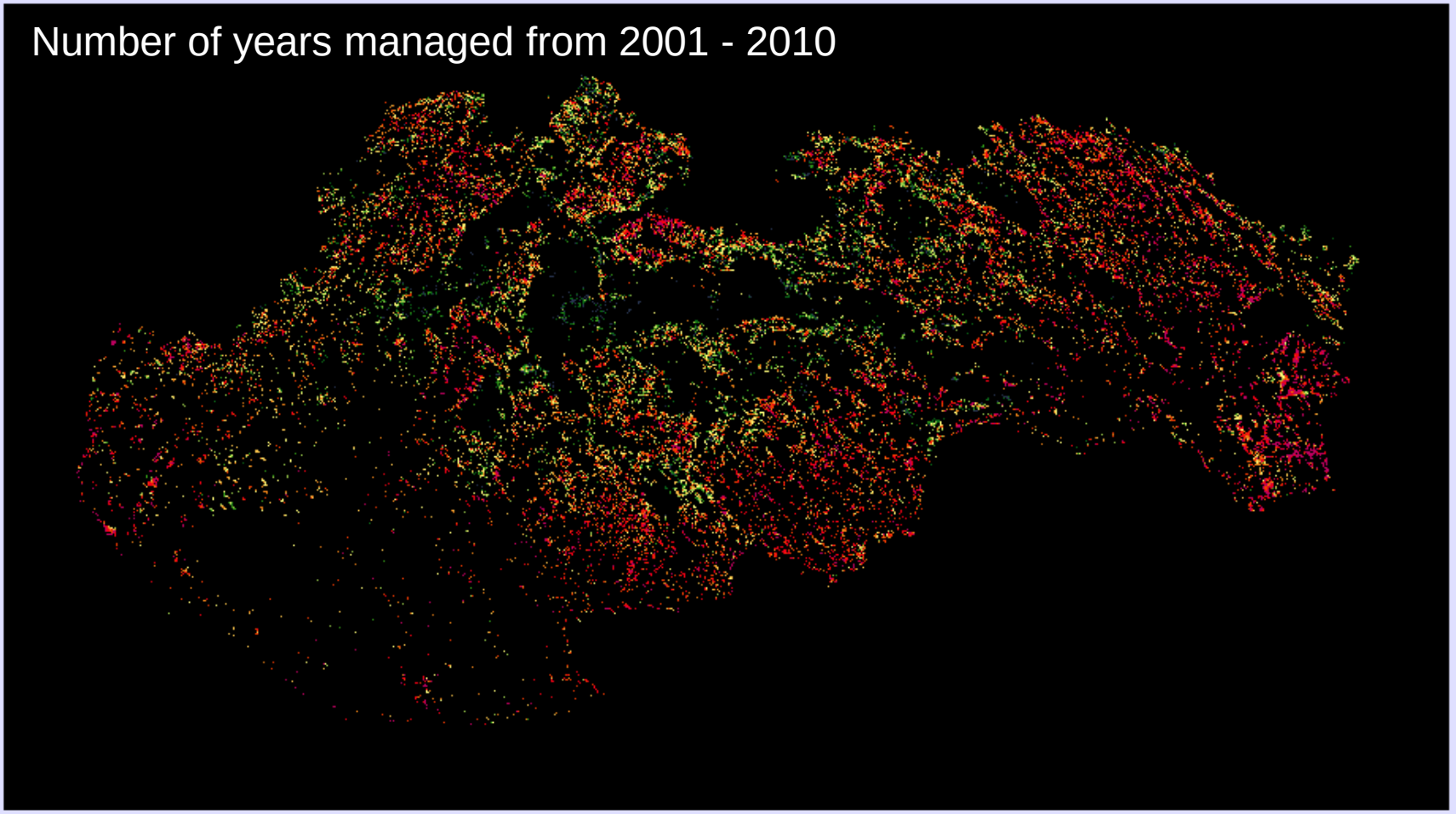
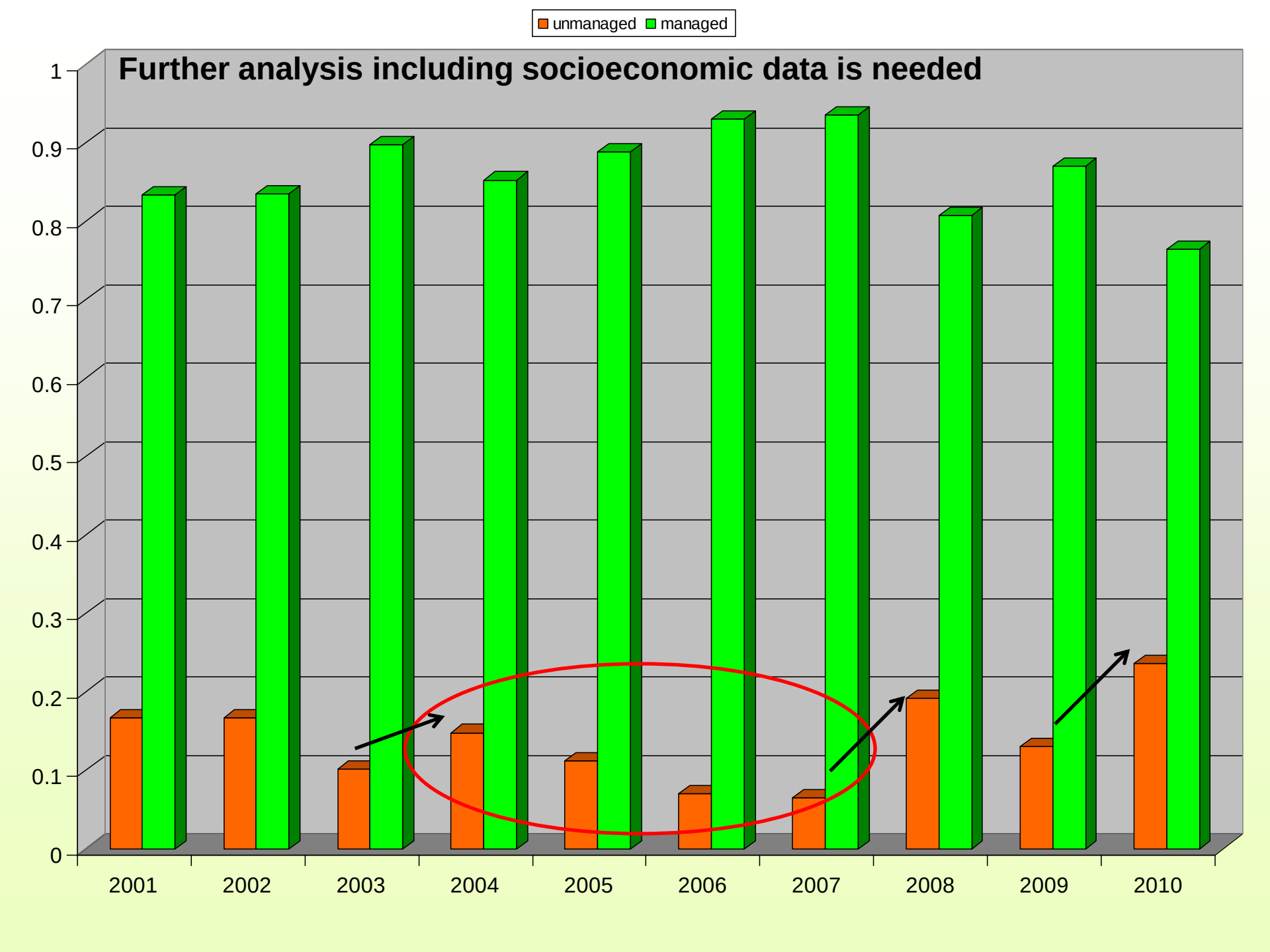
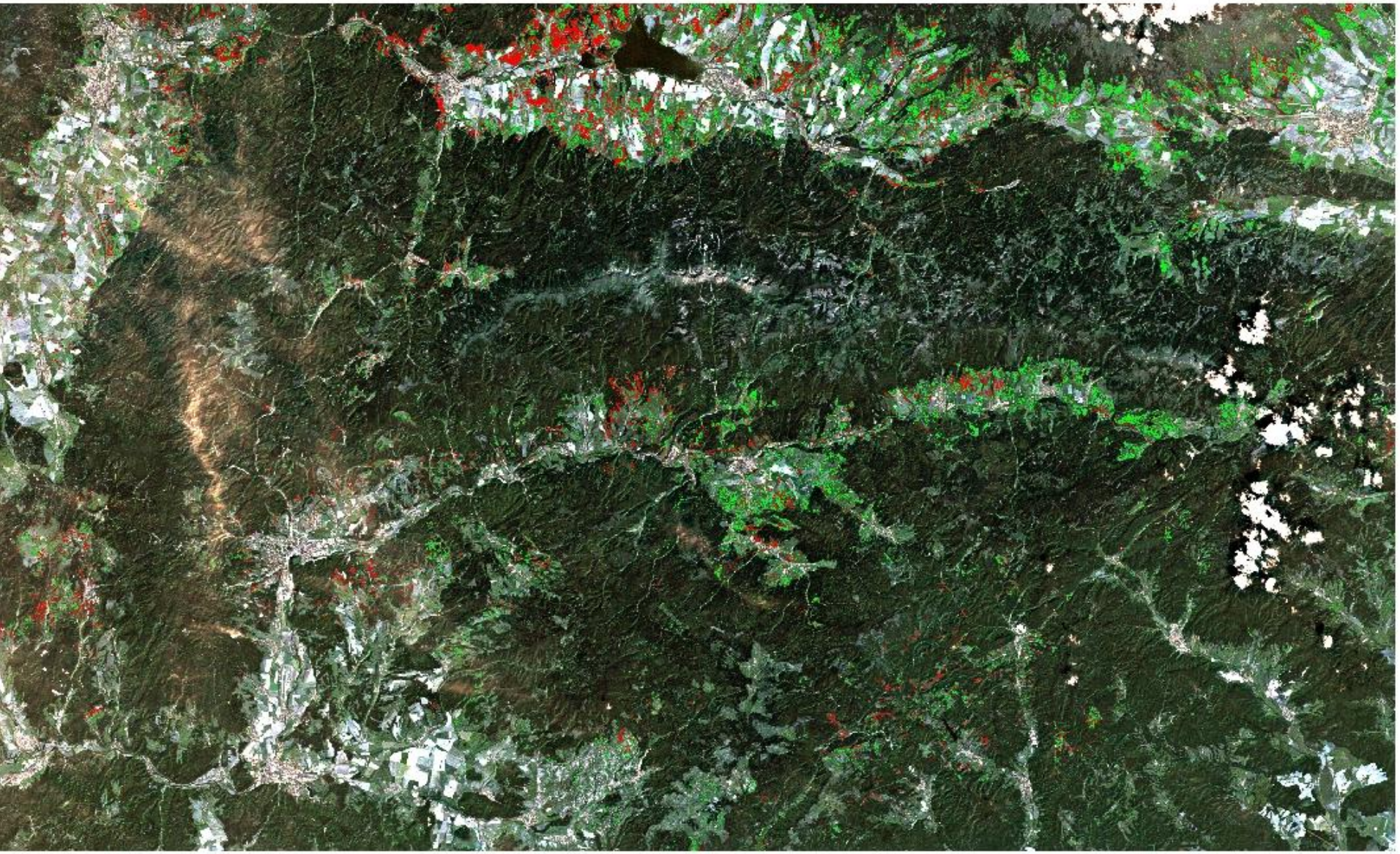
Add Layer
Remove Layer
Layer Properties
Map Properties
Feature Properties
Save
Print
RF 1 : 80546
c : 646
r : 624
x : 1370069.870414
y : 5388322.645602
start
2 Mi...
Total ...
Micro...
Idrisi
Micro...
Anglic...
SK
17:30

Cutting of hay meadows

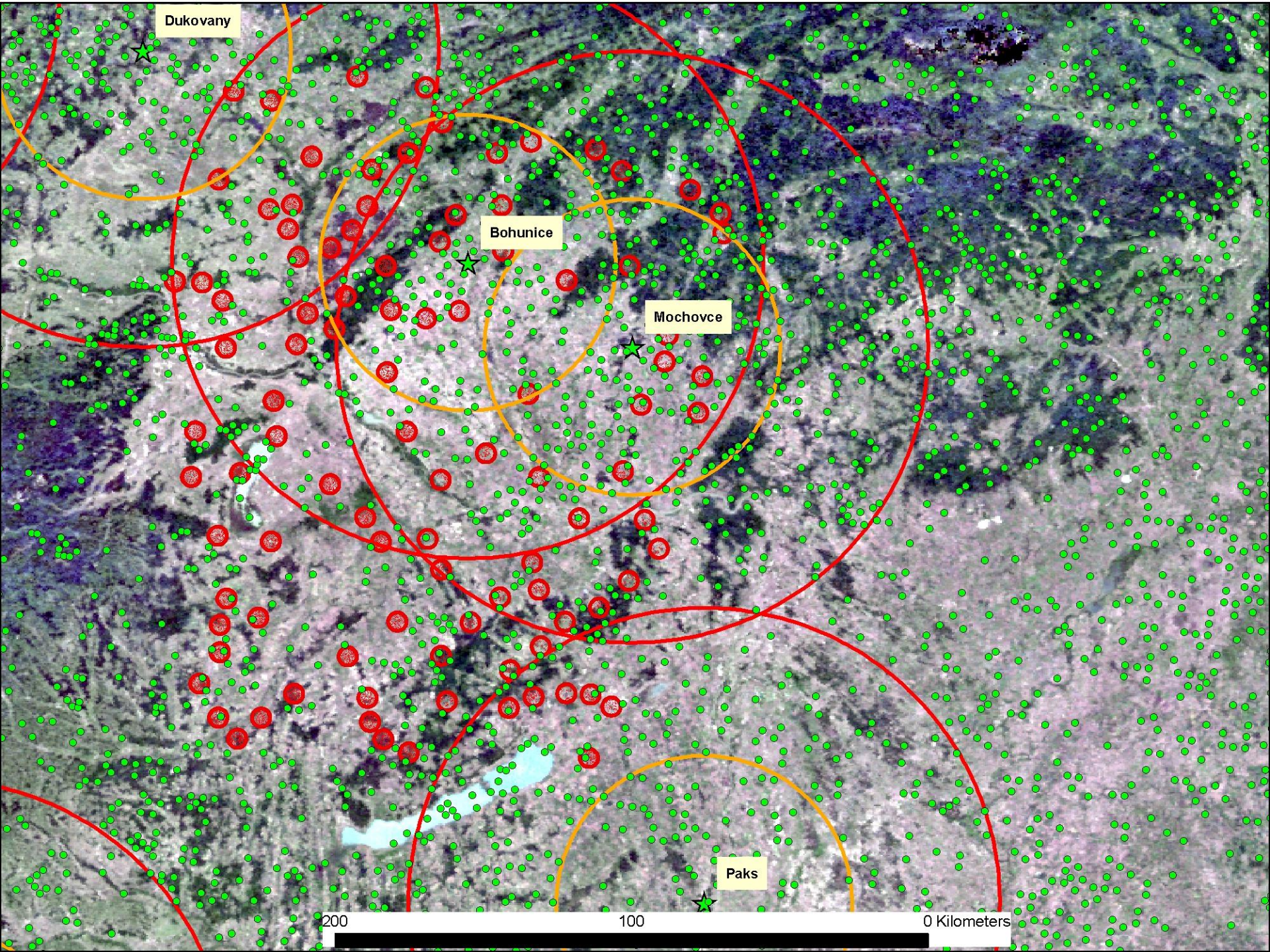
- Mainly remote and mountainious areas
- Further analysis needed including socioeonomic data
- Possible consequences – predictive modelling




unmanaged
managed
Further analysis including socioeconomic data is needed
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010


0 25 50 100 Kilometers

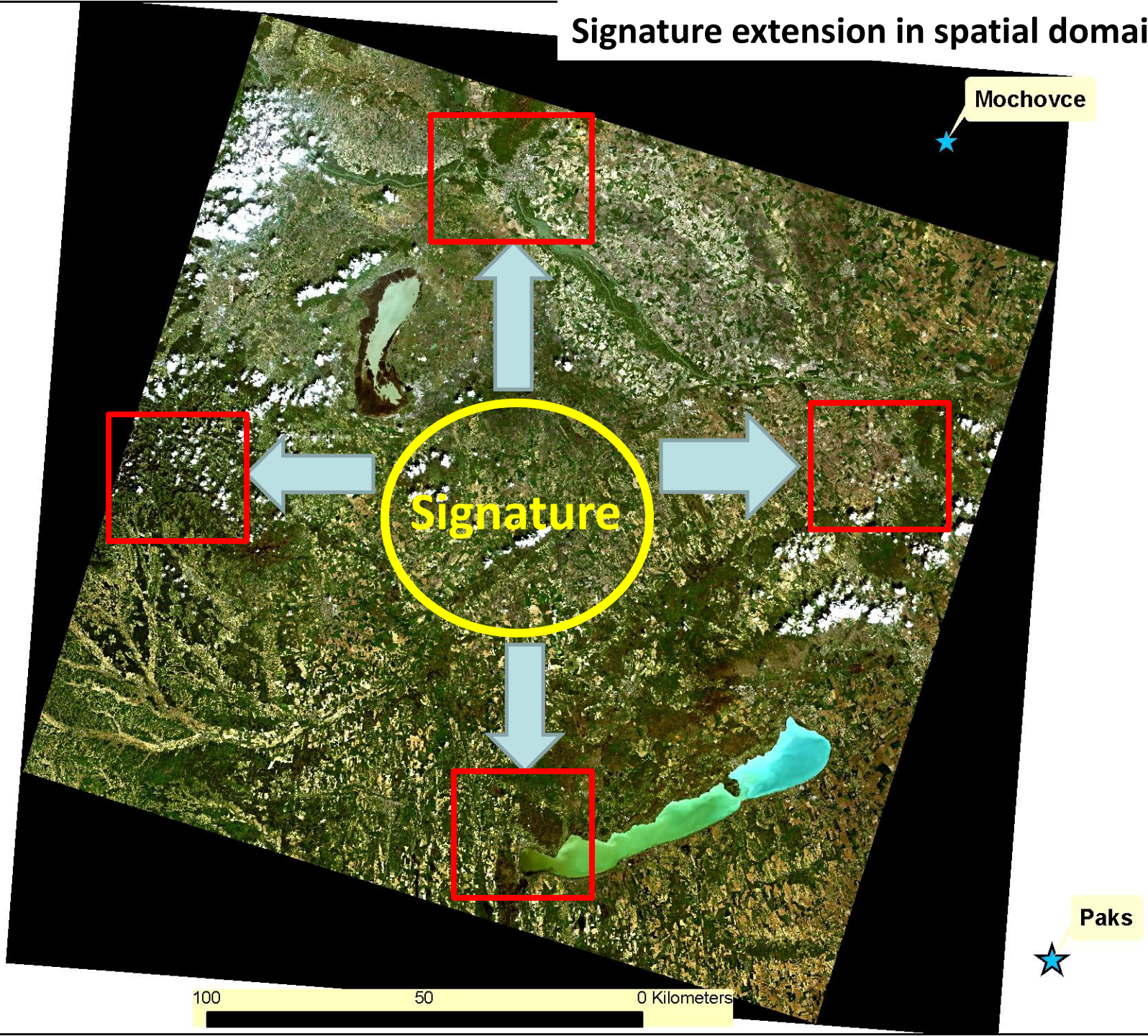
Bohunice
Mochovce
0
25
50
Kilometers


Dukovany
Bohunice
Mochovce
Paks
200
100
0 Kilometers

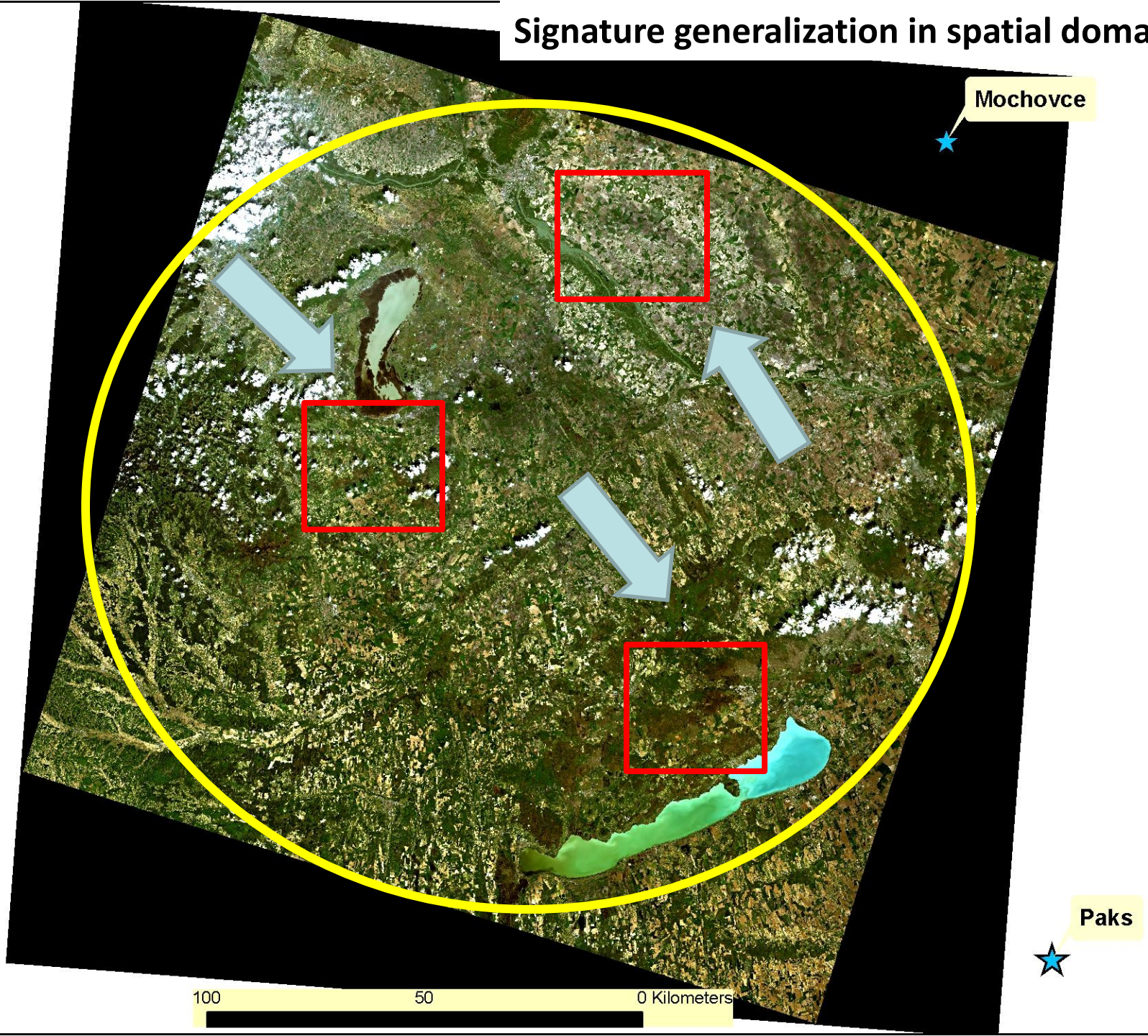
How to generalize – the issue of generalization

- Spatial – how far we can generalized crop signature?
  - region dependent – the function of crop practice similarity (eg. In areas with similar crop composition)
- Temporal - in areas with similar inter-seasonal (between year) variability
  - In general (from the research) – temporal is more succesful than spatial)
- What is crucial – Atm. correction and temporal radiometric normalization – common scale – TOC SR
  - Optimalization of the number of input predictors (as for the robustness for generalization)

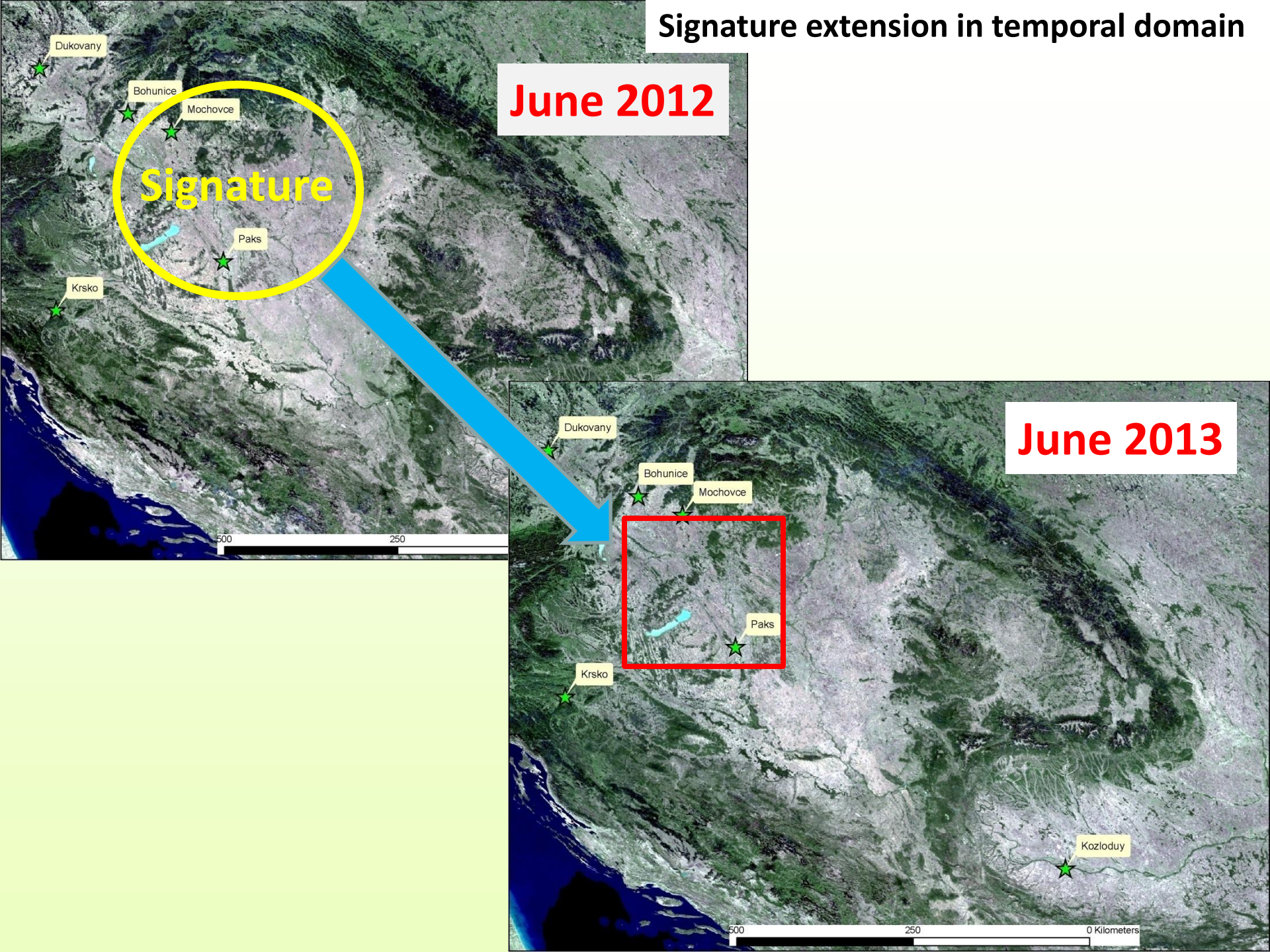
Signature extension in spatial domain



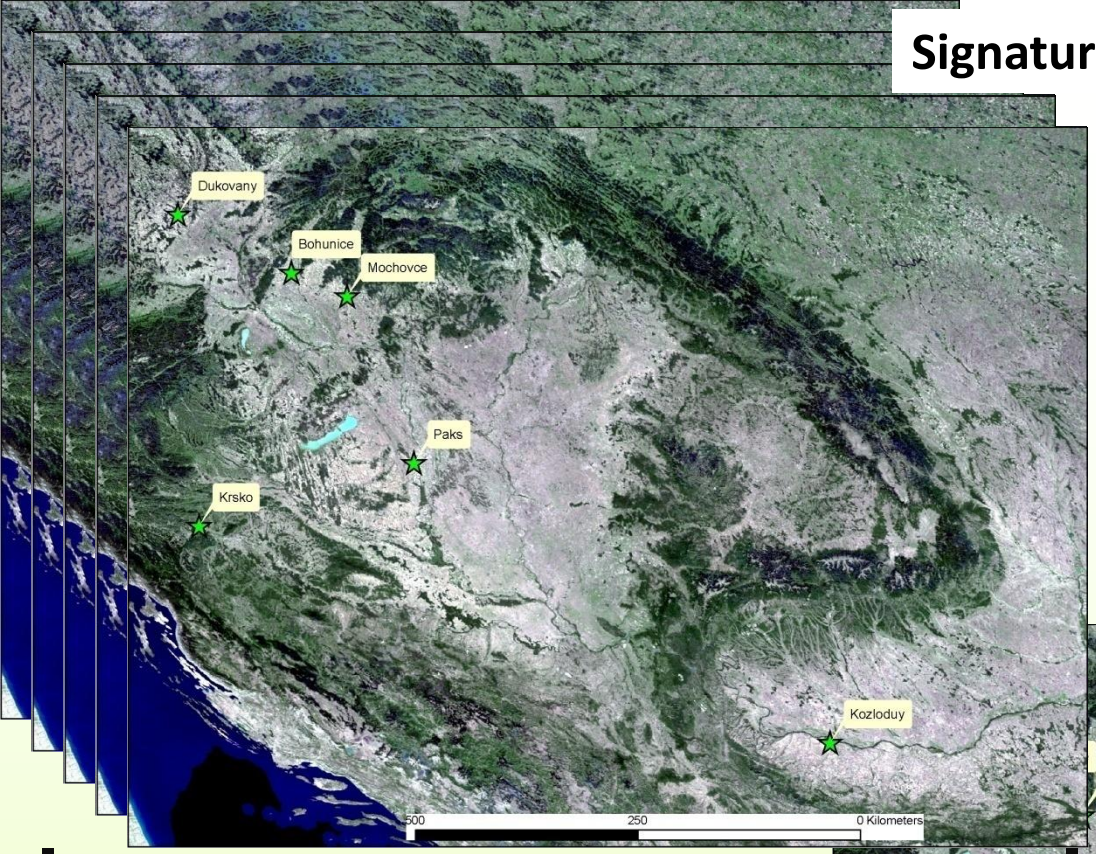
Signature generalization in spatial domain



Signature extension in temporal domain

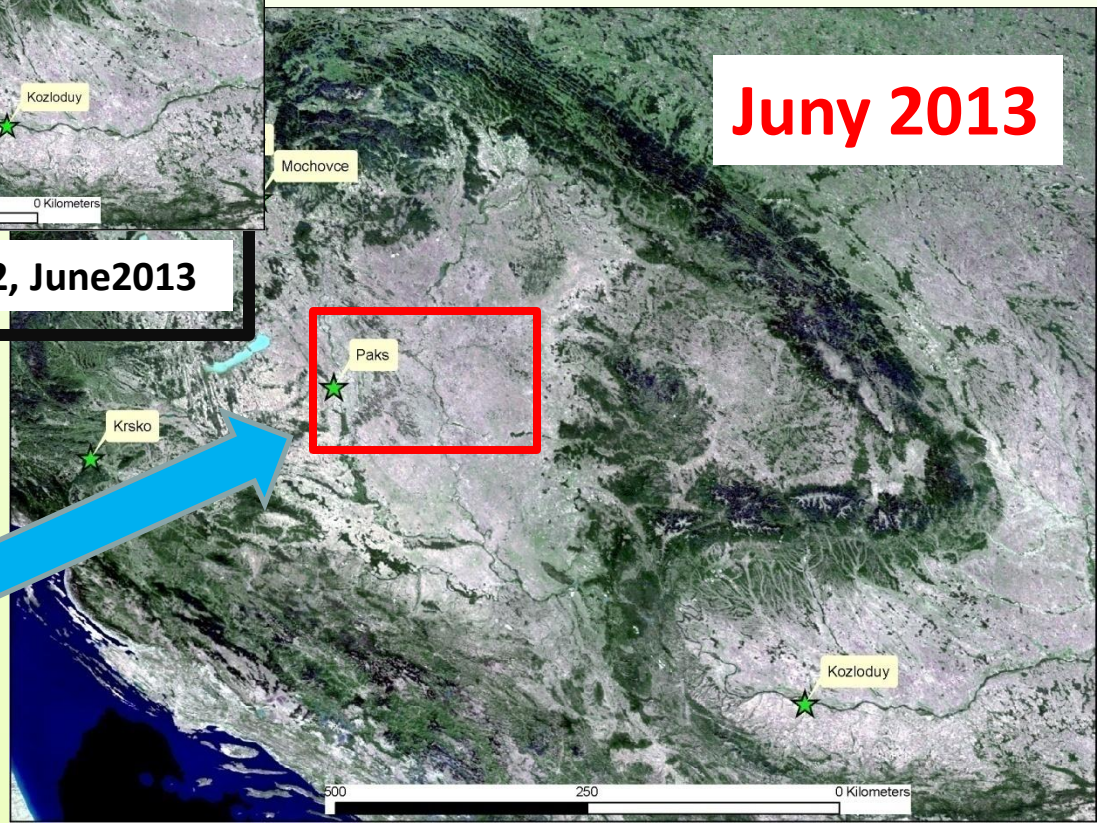


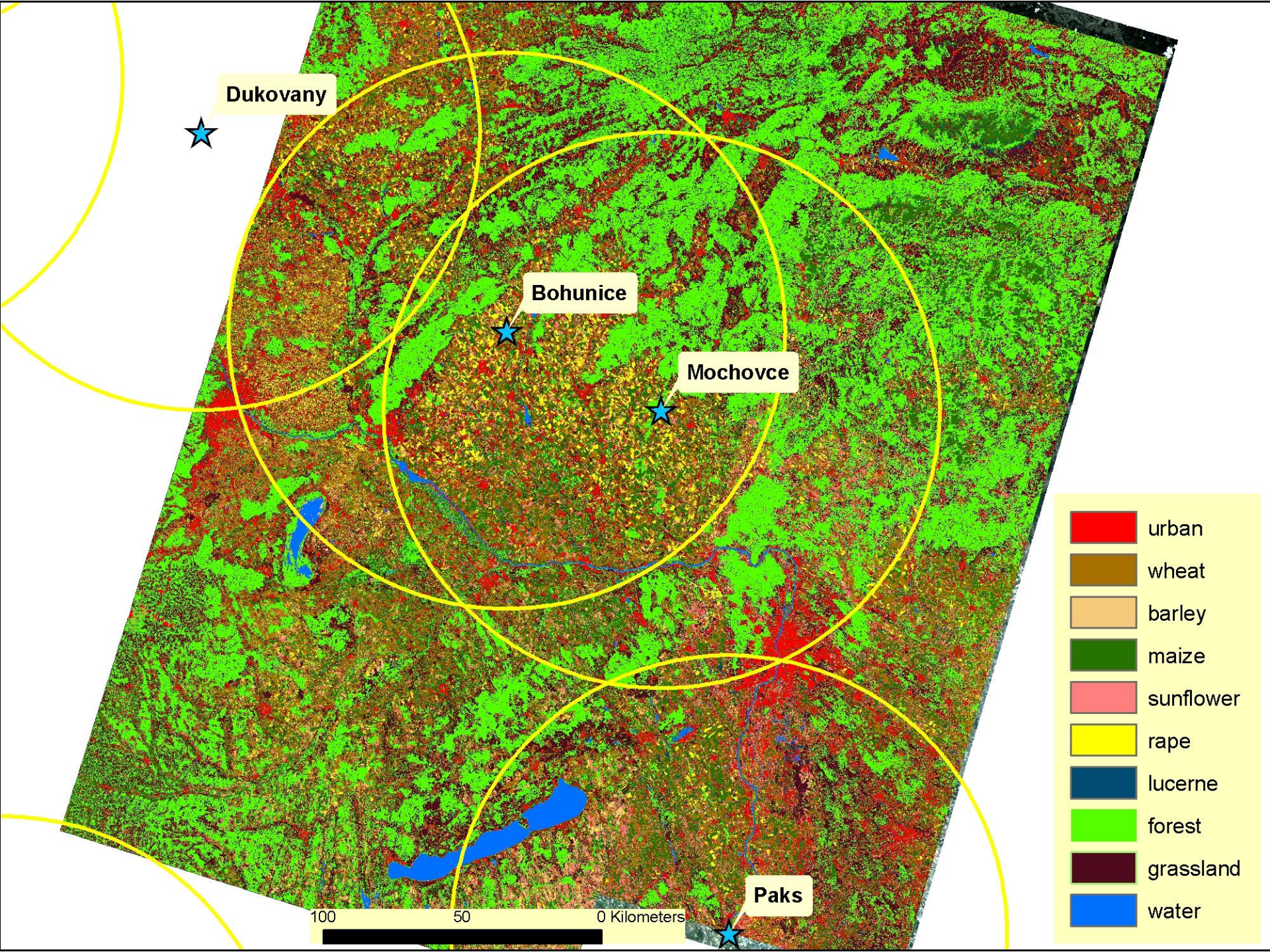
Signature generalization in temporal domain

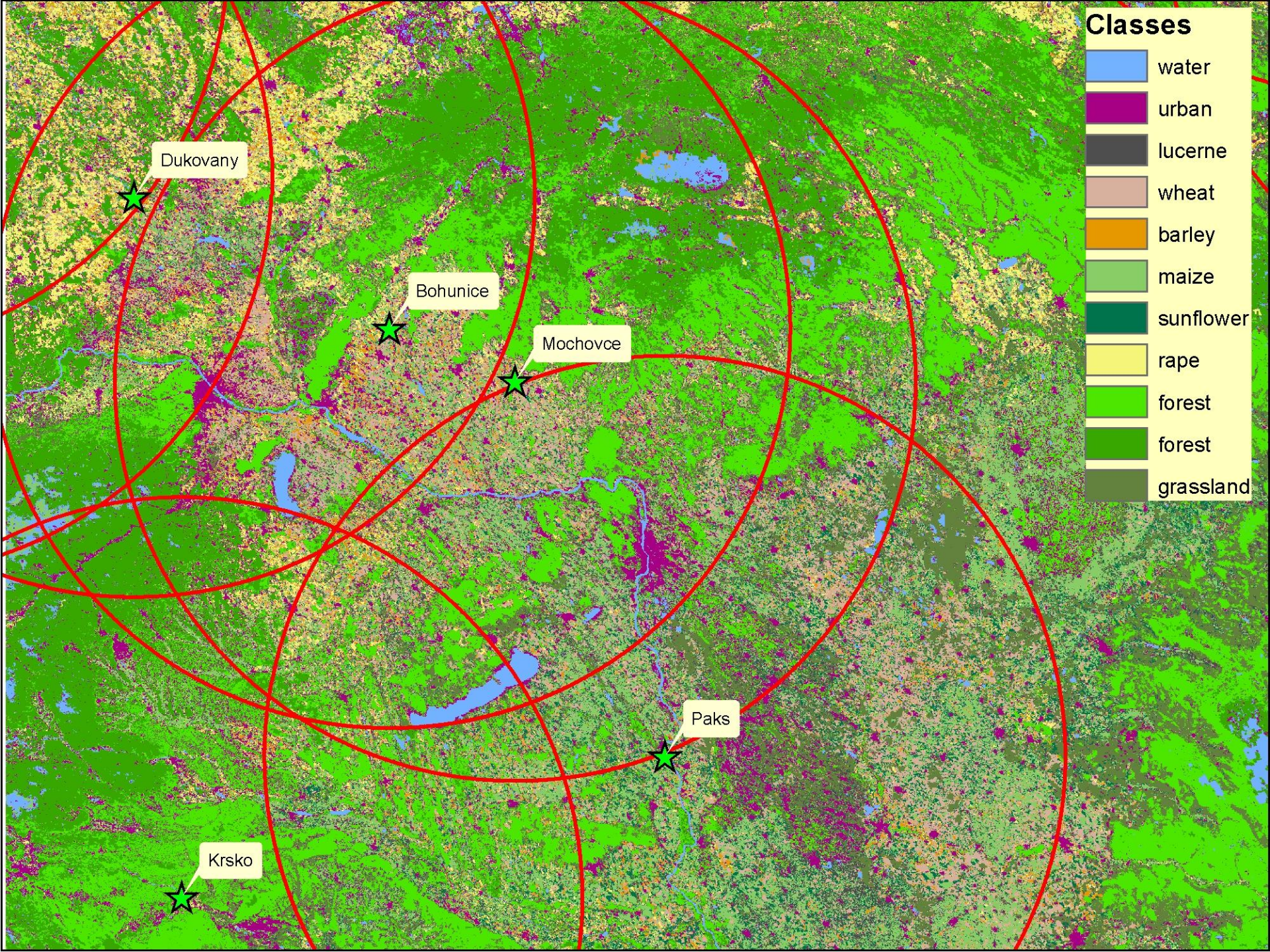


June2009, June2010, June2011, June2012, June2013

Signature




Dukovany
Bohunice
Mochovce
Paks
100
50
0 Kilometers
urban
wheat
barley
maize
sunflower
rape
lucerne
forest
grassland
water


Classes
water
urban
lucerne
wheat
barley
maize
sunflower
rape
forest
forest
grassland
Dukovany
Bohunice
Mochovce
Paks
Krsko

Issue of spatial generalization – early season

Mochovce regional (L08_188_26) 2013_139 validation

	w	b	m	s	r	l	g		UA
w	2758	142	0	7	23	0	0	2930	0.94
b	32	412	0	1	0	3	7	455	0.91
m	1	22	204	205	1	153	0	586	0.35
s	0	1	79	55	0	0	0	135	0.41
r	11	0	0	47	1344	0	0	1402	0.96
l	0	22	0	2	4	425	0	453	0.94
g	28	61	0	3	4	35	55	186	0.30
	2830	660	283	320	1376	616	62	*6147*	
PA	0.97	0.62	0.72	0.17	0.98	0.69	0.89		0.85

Mochovce regional (L08_188_27) 2013_139 validation

	w	b	m	s	r	l	g		UA
w	5919	77	10	9	188	59	167	6429	0.92
b	44	1040	2	8	4	20	41	1159	0.90
m	1	37	2735	579	5	130	11	3498	0.78
s	58	89	1349	703	51	89	56	2395	0.29
r	127	0	0	49	1833	0	16	2025	0.91
l	6	32	0	0	5	713	78	834	0.85
g	105	38	7	0	2	78	3088	3318	0.93
	6260	1313	4103	1348	2088	1089	3457	*19658*	
PA	0.95	0.79	0.67	0.52	0.88	0.65	0.89		0.82

Issue of spatial generalization – top season

Mochovce regional (L08_189_27) 2013_210 validation SK

	w	b	m	s	r	l	g		UA
w	6094	1128	95	34	1409	92	256	9108	0.67
b	1014	360	20	1	294	0	57	1746	0.21
m	28	7	3913	739	58	75	14	4834	0.81
s	3	2	174	965	3	0	1	1148	0.84
r	584	30	0	0	456	5	0	1075	0.42
l	0	0	4	23	22	268	28	345	0.78
g	280	6	122	57	54	177	3462	4158	0.83
	8003	1533	4328	1819	2296	617	3818	*22414*	
PA	0.76	0.23	0.90	0.53	0.20	0.43	0.91		0.69

Mochovce regional (L08_189_26) 2013_210 validation HU

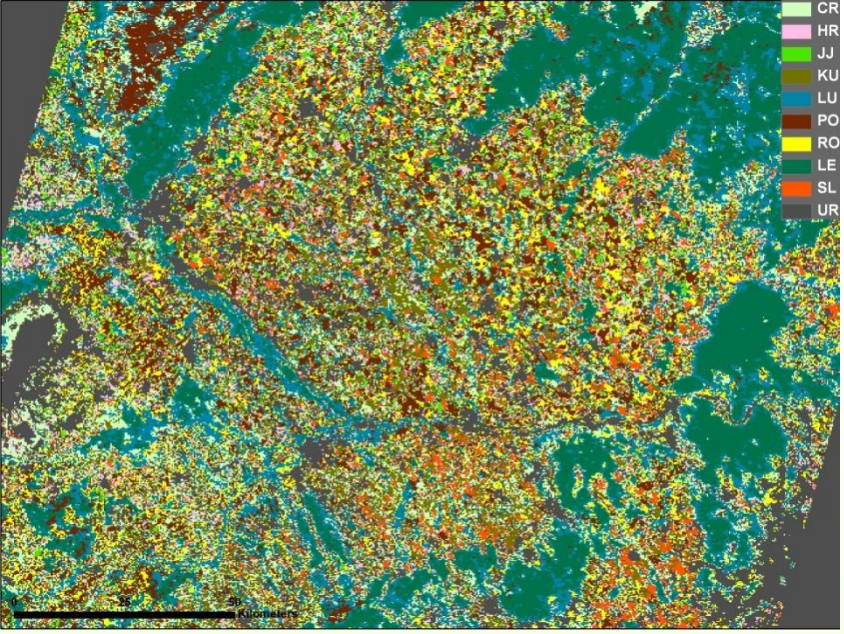
	w	b	m	s	r	l	g		UA
w	5371	1230	78	45	1069	175	25	7993	0.67
b	96	190	1	1	64	1	0	353	0.54
m	18	7	4461	270	11	81	8	4856	0.92
s	0	0	188	421	0	0	0	609	0.69
r	1504	471	110	33	2584	57	0	4759	0.54
l	1	1	0	0	0	131	1	134	0.98
g	132	81	57	7	37	597	1785	2696	0.66
	7122	1980	4895	777	3765	1042	1819	*21400*	
PA	0.75	0.10	0.91	0.54	0.69	0.13	0.98		0.70

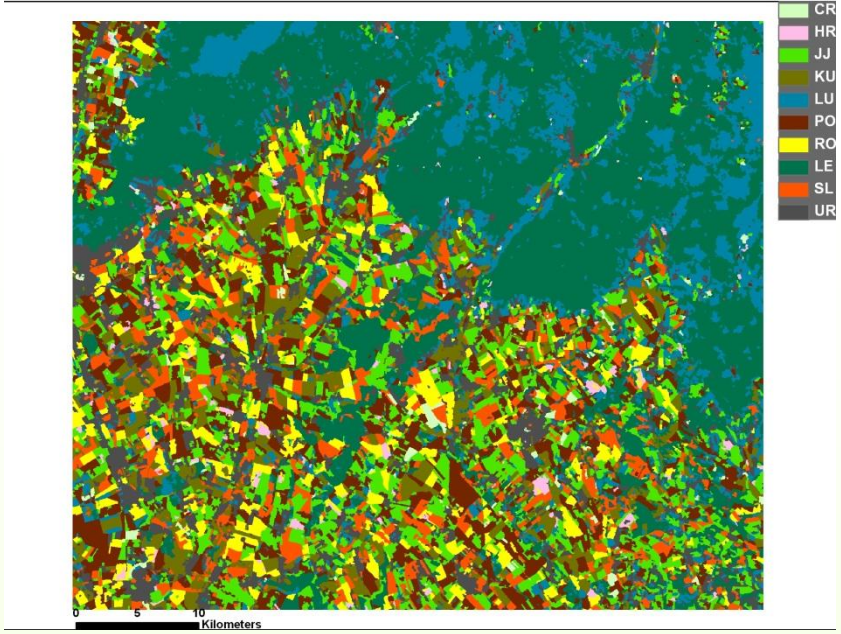
Temporal extension – top season

Mochovce regional (L08_188_27) 2013_06_21 - using signature from Mochovce local (L05_188_27) 2011_06_15

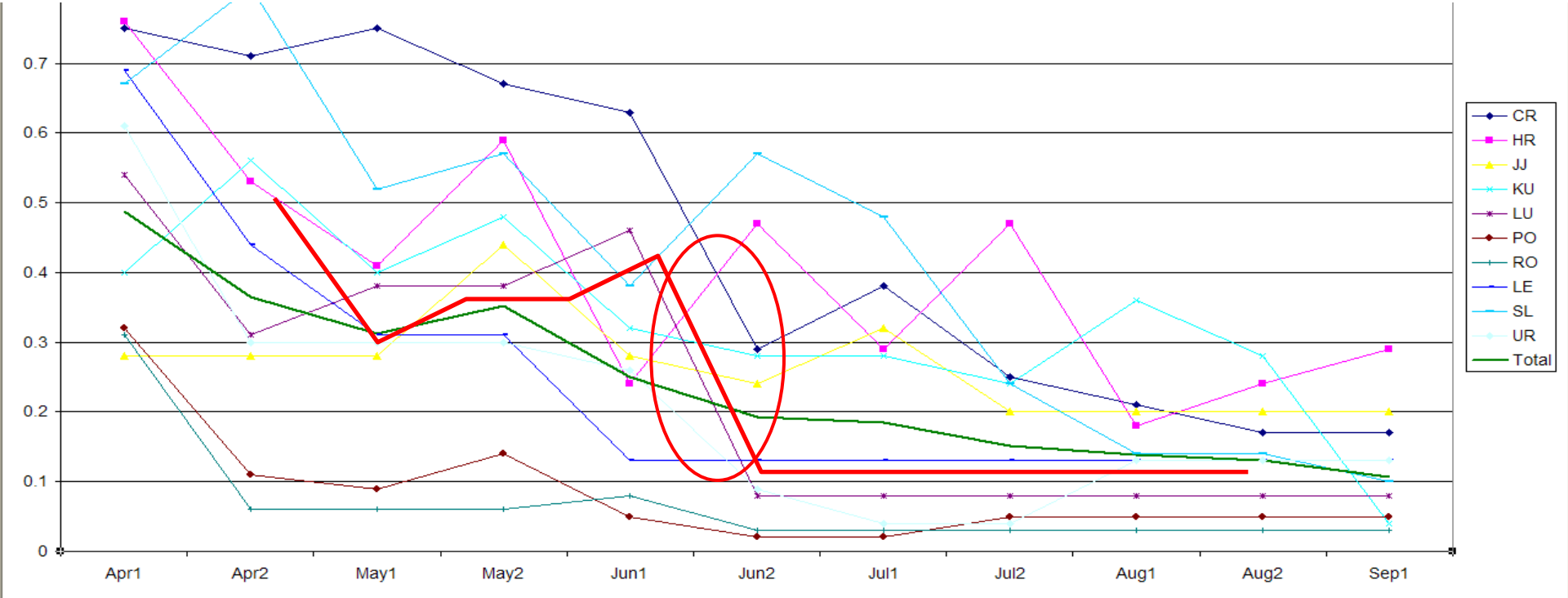
	wheat	barley	maize	sunflower	rape	grassland	Total	UsersAccur
wheat	8688	513	184	51	372	126	9934	0.87
barley	1189	2334	38	77	229	116	3983	0.59
maize	189	176	3461	234	37	230	4327	0.80
sunflower	120	260	893	2072	27	1690	5062	0.41
rape	286	26	0	44	3514	144	4014	0.88
grassland	5	0	125	36	6	113	285	0.40
Total	10477	3309	4701	2514	4185	2419	27605	
ProdAccur	0.83	0.71	0.74	0.82	0.84	0.05		0.73

Better than for early season – OA 63% - grater spatial variability in early season





Errors decreased dramatically after the crop harvesting in late June



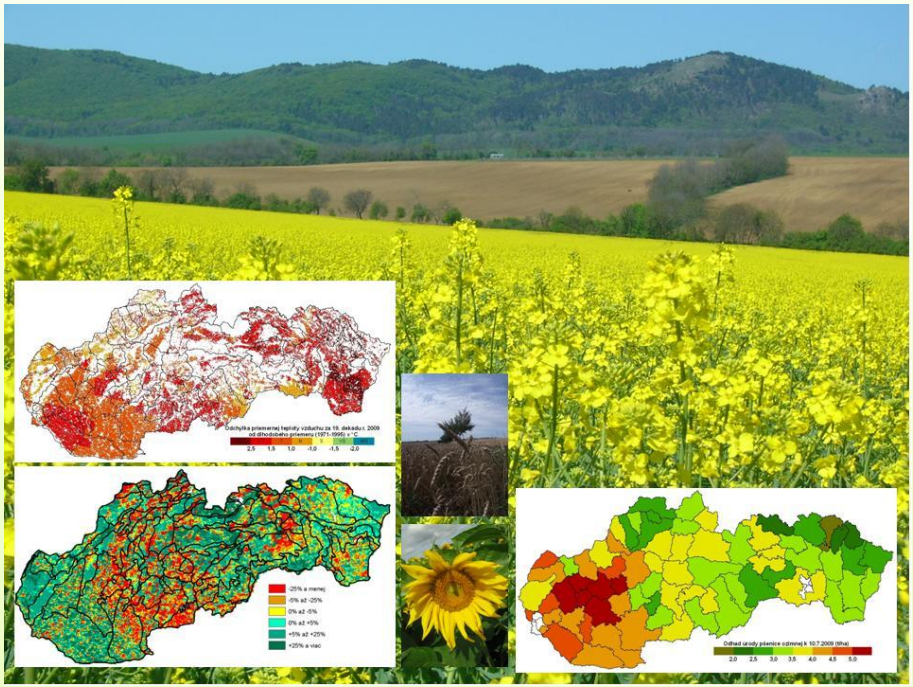
Landscape and Ecosystem Research
Key Capabilities and Infrastructure

Current and future research focus

- Optimal filtering of MODIS series for grassland studies and crop monitoring
- Early season crop prediction
- Testing of consistent classification methods allowing quarterly crop monitoring (signature extension and generalization)
- Optimalization and minimalization of field training
- Data fusion MODIS and Landsat (prediction of Landsat NDVI series)

Agriculture Research

SOIL SCIENCE AND CONSERVATION RESEARCH INSTITUTE BRATISLAVA, SLOVAKIA



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Tel.: +421-2-48 20 69 76
Fax.: +421-2-43 41 11 05
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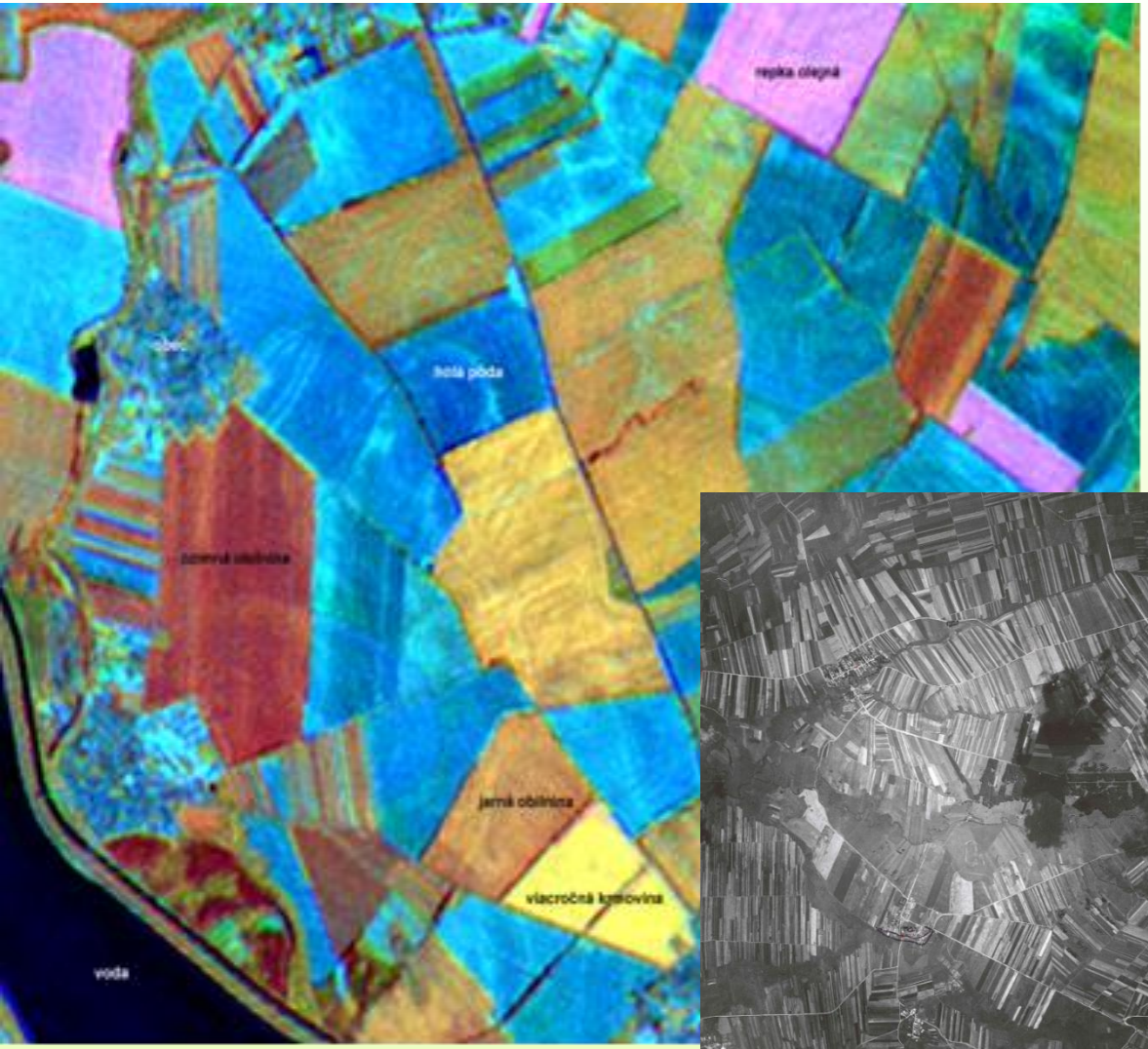
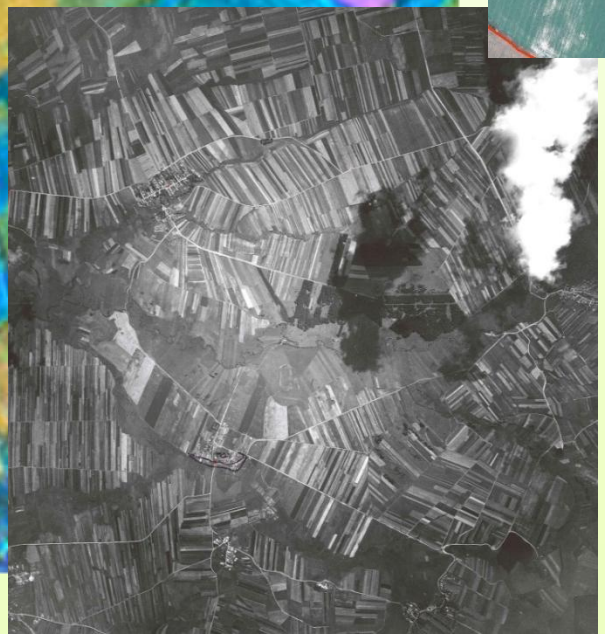
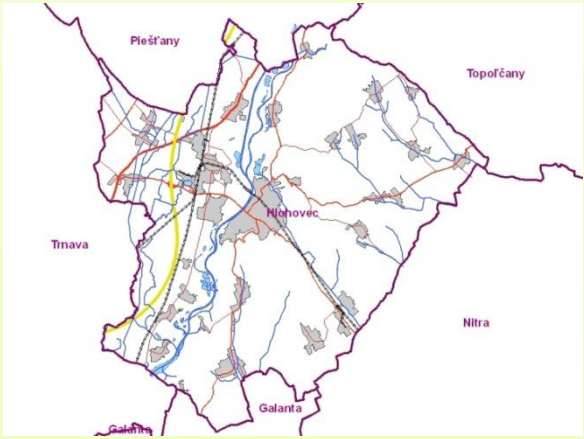
www.vupop.sk

Department of remote sensing and information technology



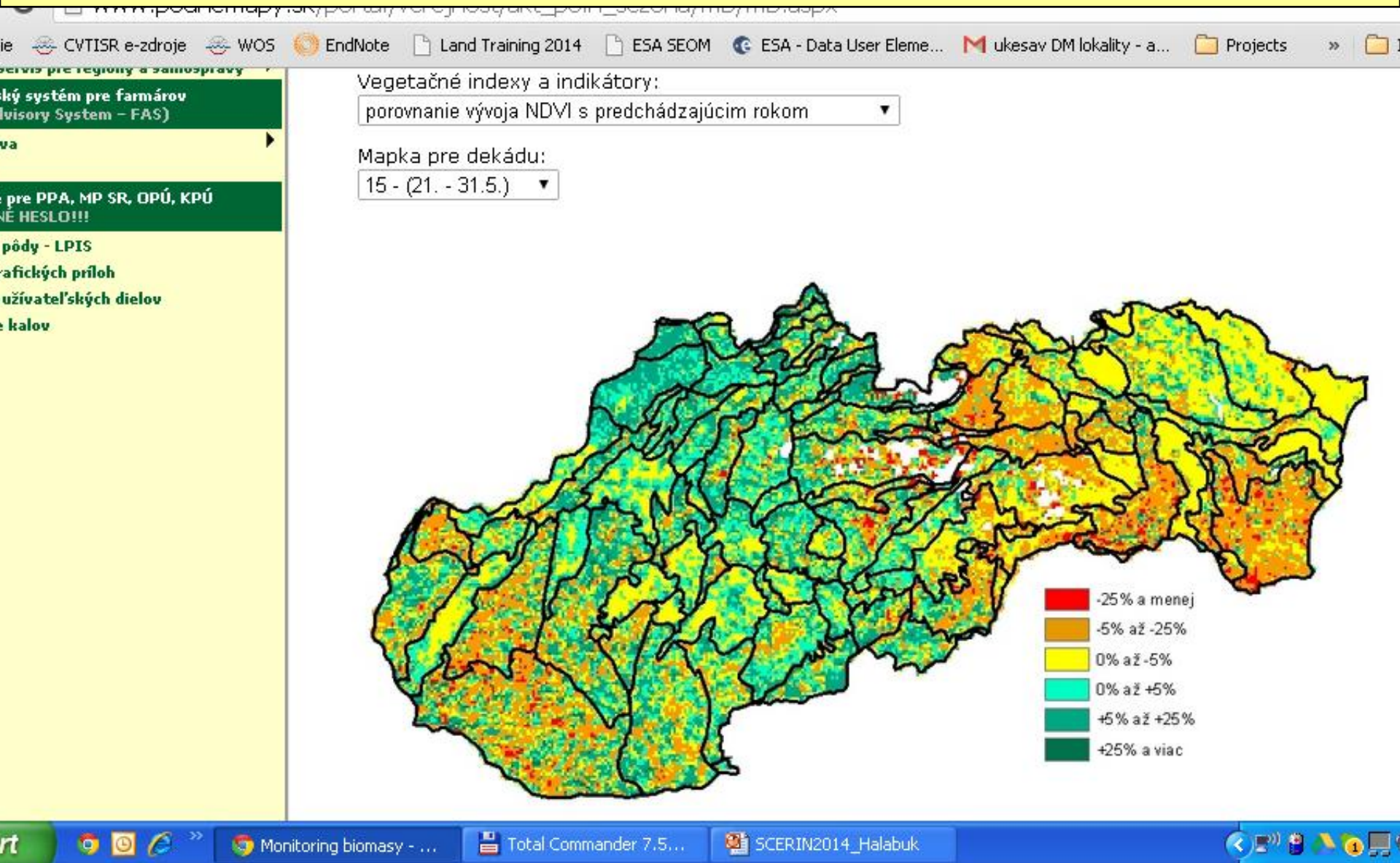




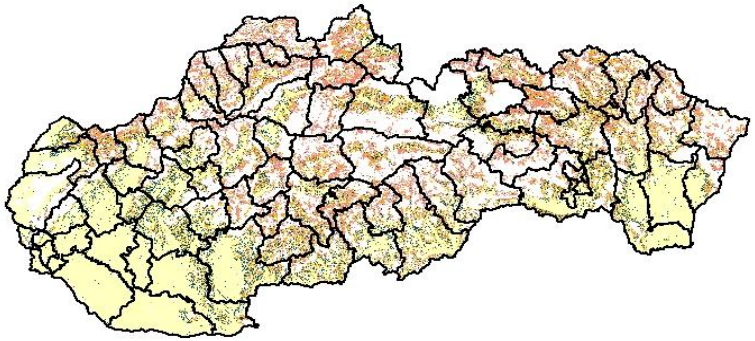
Department of remote sensing and informatics on technology

- **Creation and continuous updating of the Land Parcel Identification system (LPIS)**
- **Land degradation monitoring by remote sensing**
- **Remote Sensing Control of area based – subsidies**
- **Survey of land use and land cover (LUCAS) – agro-environmental survey**
- **National system for the estimation of yields and the application and update the production of agricultural crops (SK_CGMS)**
- **Identification ownership and users on agricultural land**

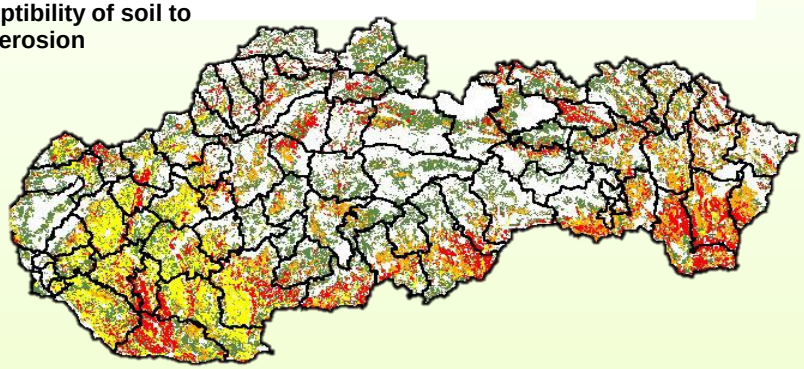
Web Portal for Agriculture Information



Ancillary data

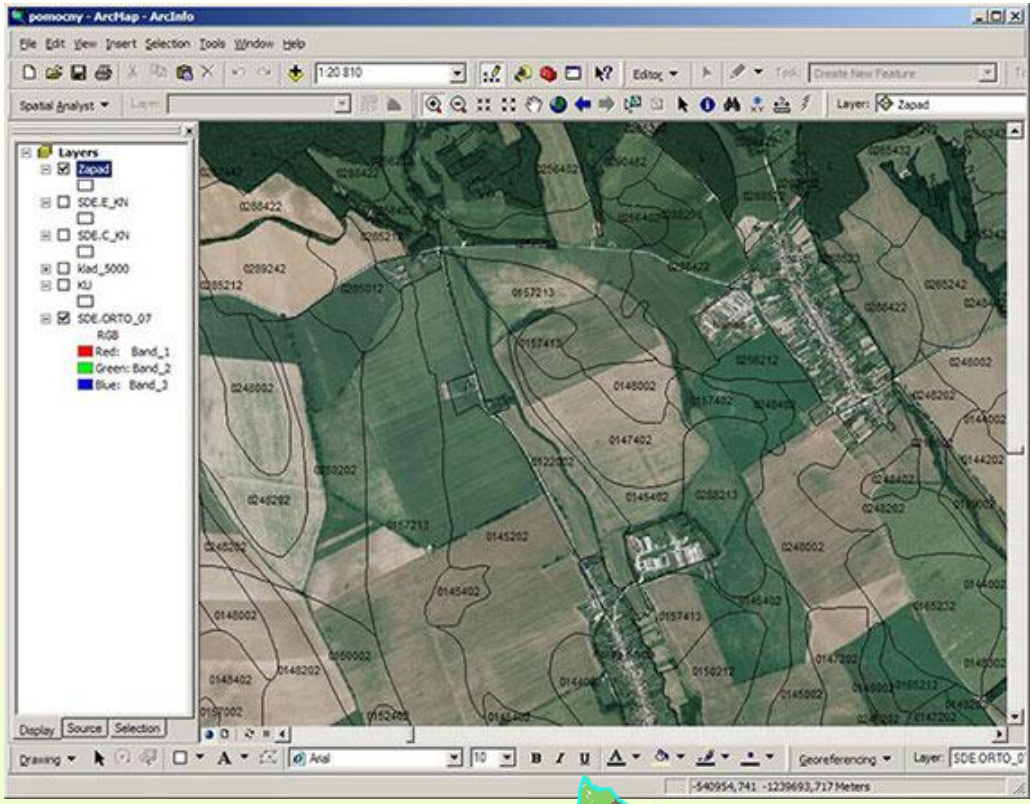


Susceptibility of soil to water erosion



Susceptibility of soil to compaction

Suitability of agricultural land for rape cultivation in Komárno reg.



Suitability of agricultural land for cultivation *maize in Komárno reg.*

Forest research

National Forest Centre Zvolen

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960 92 Zvolen, Slovakia

halvon@nlcsk.org

bucha@nlcsk.org

Technical University of Zvolen

Prof. Ján Tuček, CSc.

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960 92 Zvolen, Slovakia

jan.tucek@tuzvo.sk

Forest Research Key Topics

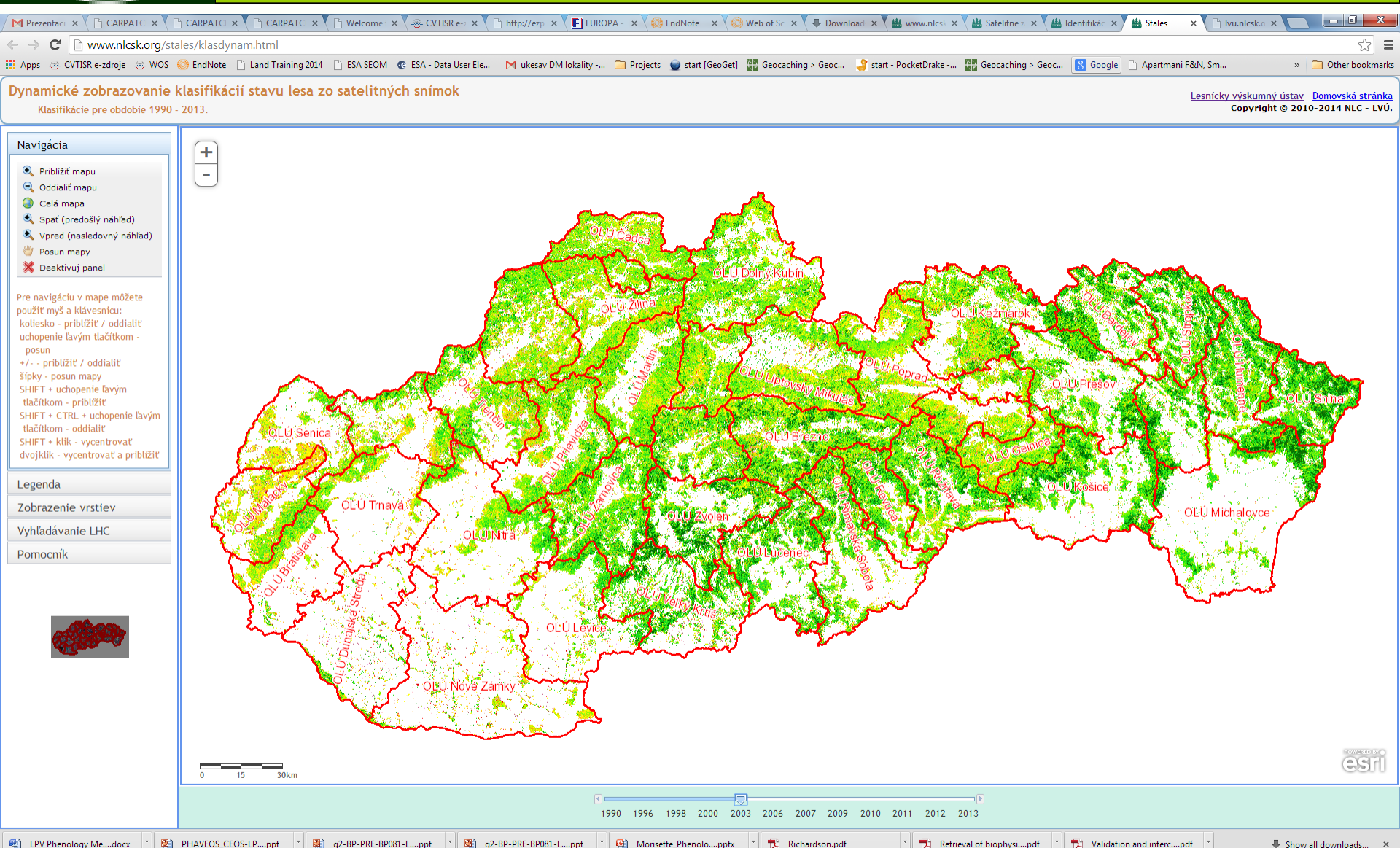
- improvement of monitoring and forest inventory methodologies, mainly by using Lidar data

- harmonization in building of software infrastructure and sharing of algorithms developed for processing Lidar data

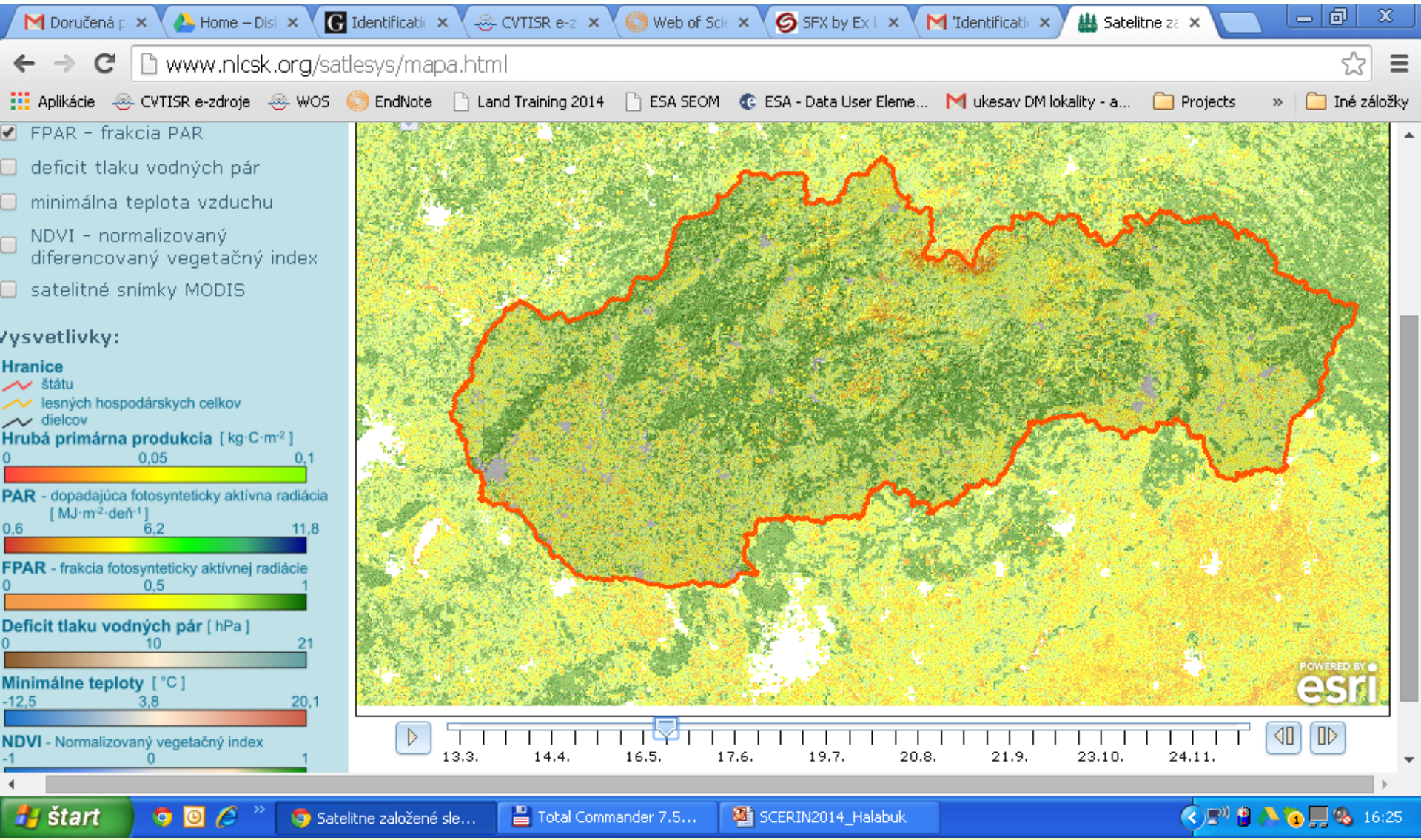
- applying the research – building of operational products for forest mapping, forest management, forest production, forest protection, and other supporting ecosystem services (e.g. biodiversity, recreational, flood protection)

- providing web and map services to users, downscaling of global and continental products to national scale

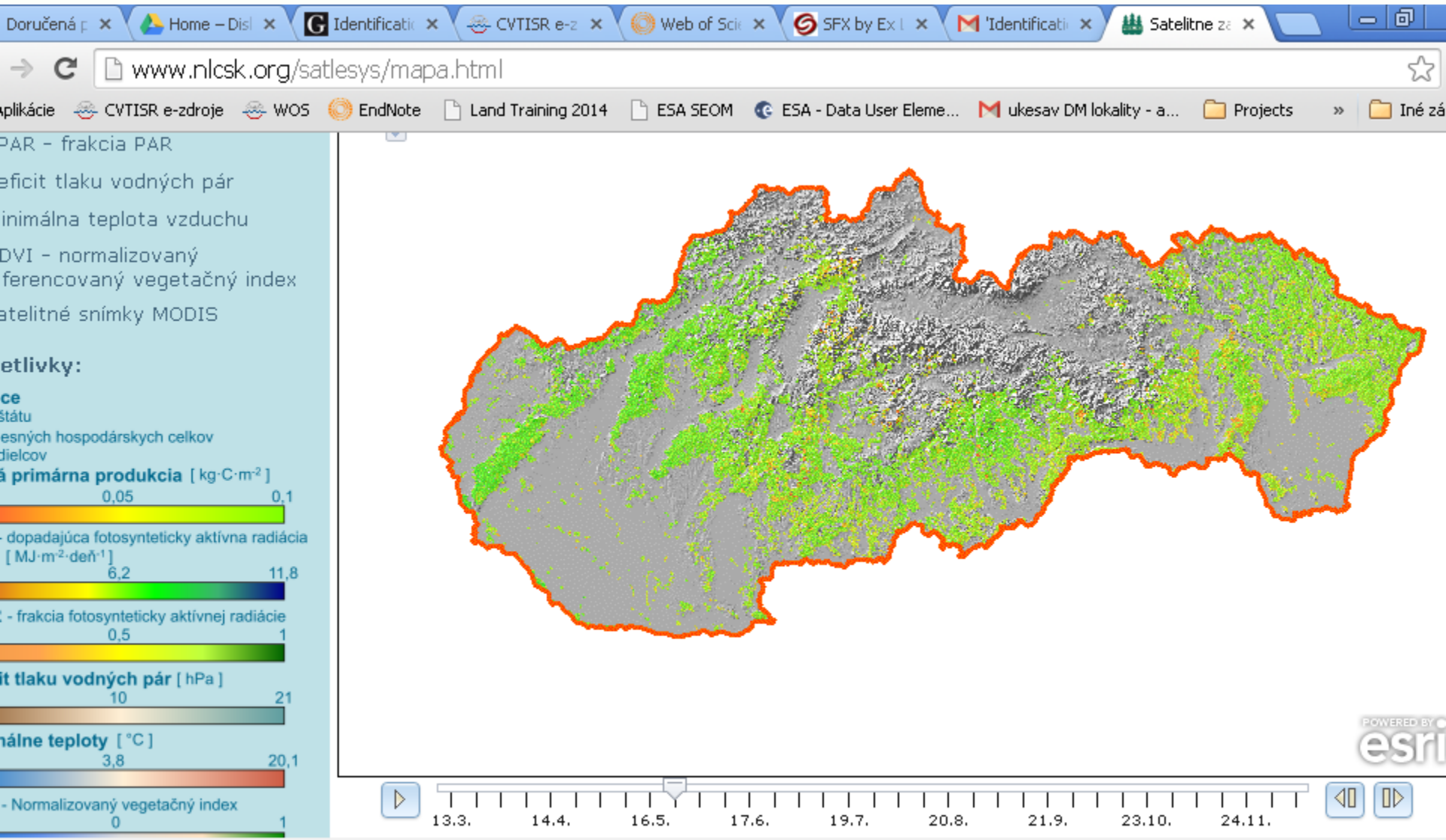
National Forest Centre
Key Topics



National Forest Centre
Key Topics



National Forest Centre
Key Topics

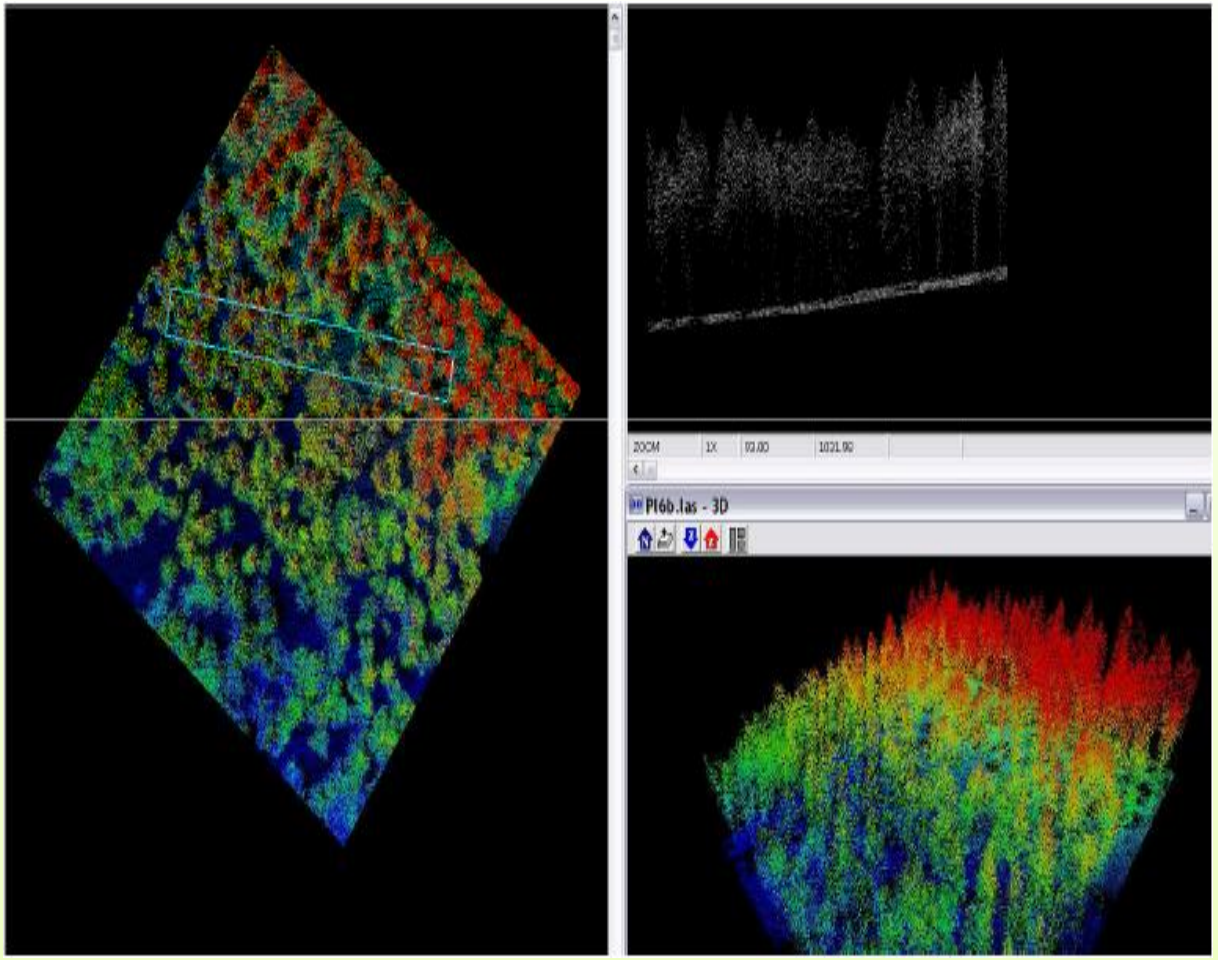


National Forest Centre Infrustructure and Capabilities

DATA PROCESSING – LASER SCANNING

- TerraScan
- TerraModeler
- TerraPhoto
- TerraSurvey

- DTM Master
- SCOOP++
- SCOOP++ Analyzer
- SCOOP++ Visualizer



DATA PROCESSING - PHOTOGRAMMETRY

- ISAT
- OrthoPro
- ISAE
- ISSD
- ISDC

- MATCH AT
- OrthoMaster
- OrthoVista

- LPS Core
- LPS Stereo
- ORIMA DP-TE/GPS
- Stereo Analyst for ArcGIS
- FeatureAssist for ArcGIS

DATA ACQUISITION - AIRBORNE

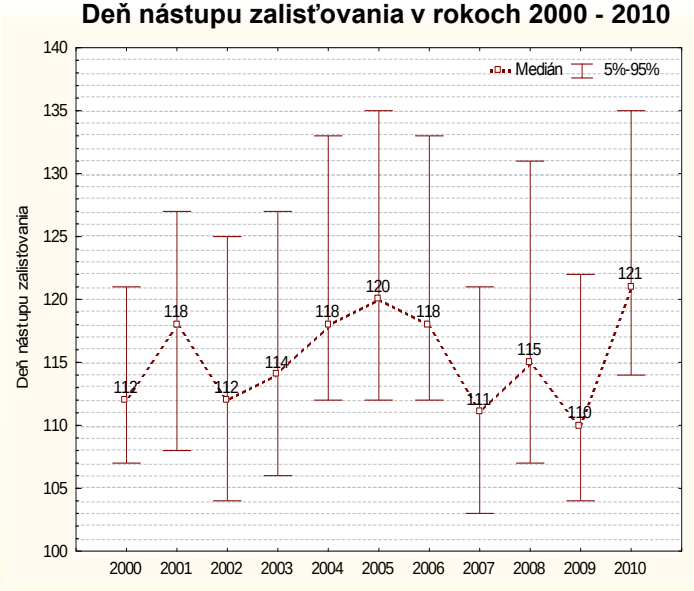
- Leica ALS70-CM Airborne LIDAR Sensor
- Leica RCD30 multispectral camera
- PAV 80 + flight mission and execution SW

DATA PROCESSING – REMOTE SENSING

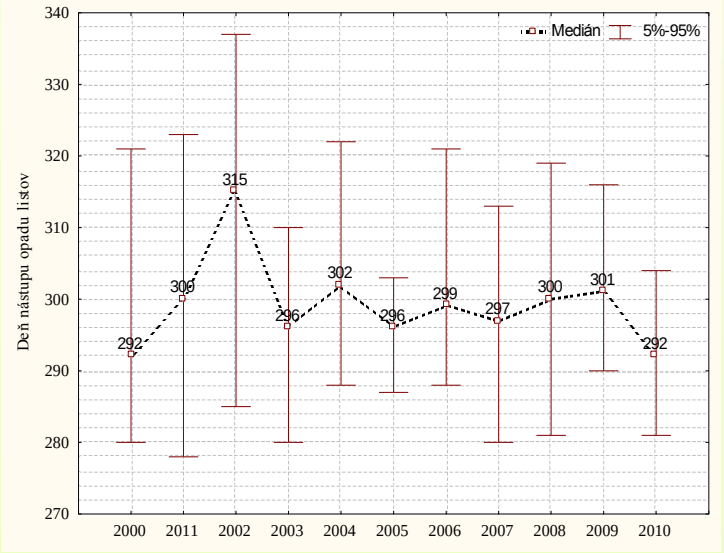
- ERDAS IMAGINE Professional
- IMAGINE Objective
- IMAGINE DeltaCue
- IMAGINE AutoSync
- IMAGINE Vector
- ATCOR 2 a ATCOR 3
- IMAGINE MrSID
- eCognition
- IDRISI
- ArcGIS

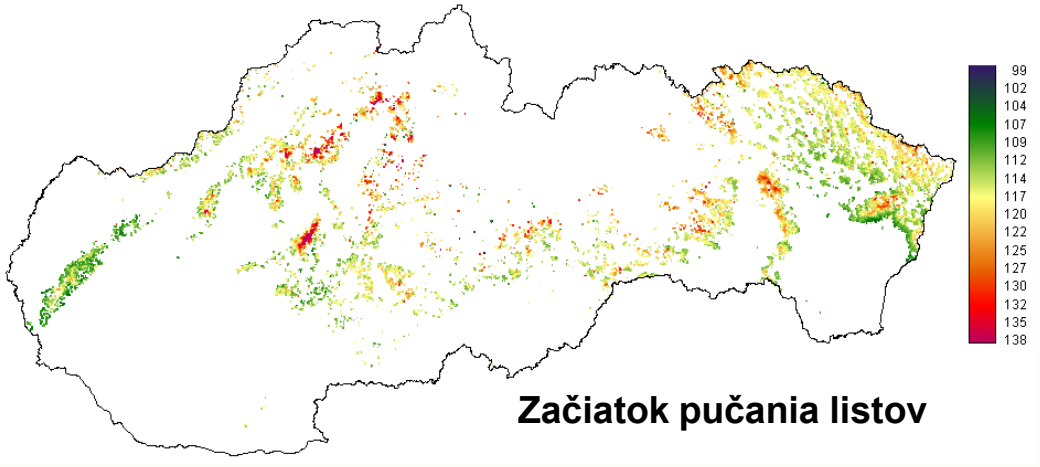
Modelovanie fenologického vývoja bukových a dubových porastov

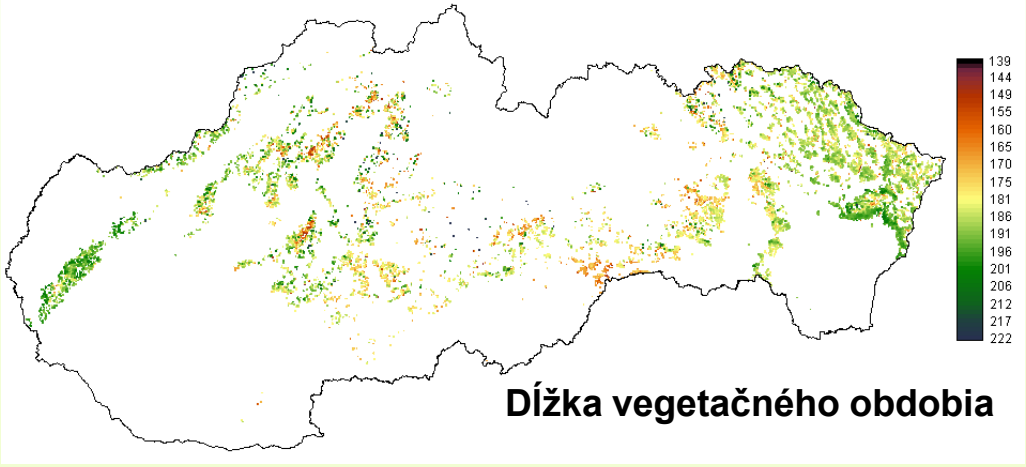
Deň nástupu zalisťovania v rokoch 2000 - 2010



Deň nástupu opadu listov v rokoch 2000 - 2010





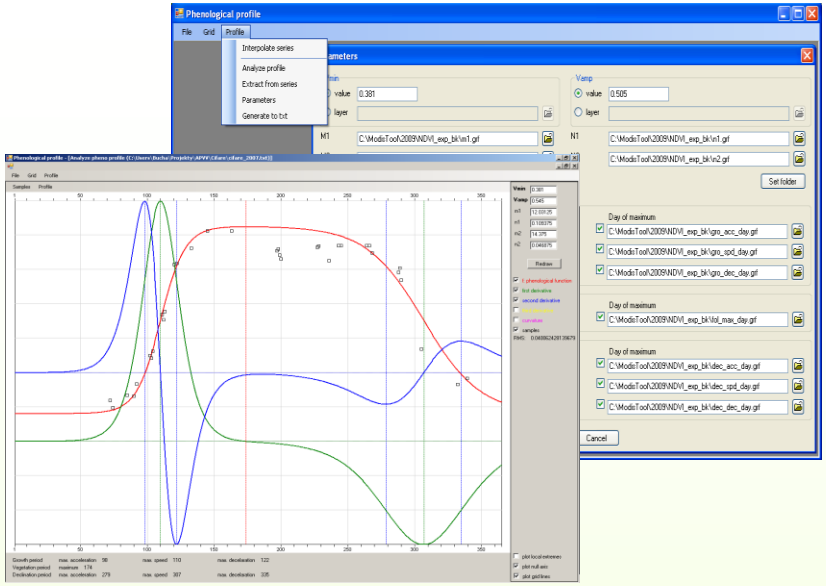


Fenologické fázy dreviny dub cerový na TMP Čifáre odsledované v rokoch 2001–2008

Rok	Začiatok pučania	Zališťovanie		Letné žltnut.	Žltnutie listov		Opad listov	
		začiatok	všeobecné		začiatok	všeobecné	začiatok	koniec
2001	25.4.	-	3.5.		25.9. (146)	26.10. (27)	26.10.	-
2002	26.4.	-	13.5.		11.10.(152)	23.10. (13)	11.10.	5.12. (56)
2003	17.4.	29.4. (13)	-		3.10.	17.10. (15)	3.10.	28.11.(57)
2004	16.4.	30.4. (15)	28.5. (29)		15.10. (141)	29.10. (15)	29.10.	26.11. (29)
2005	22.4.	29.4. (8)	27.5. (29)		30.9. (127)	14.10. (15)	28.10.	25.11. (29)
2006	21.4.	28.4. (8)	12.5. (15)		29.9. (140)	27.10. (29)	29.09.	24.11. (26)
2007	13.4.	27.4. (15)	11.5. (15)		12.10. (155)	26.10. (15)	26.10.	9.11. (15)
2008	25.4.	-	6.5.		9.10. (157)	23.10. (15)	23.10.	20.11.(29)

* údaj v zátvorke je trvanie fenofázy (dni)

Phenoprofile – softvér pre odvodenie priebehu vegetačnej krivky zo satelitných snímok MODIS,
vyvinutý v spolupráci NLC a TUZVO Zvolen



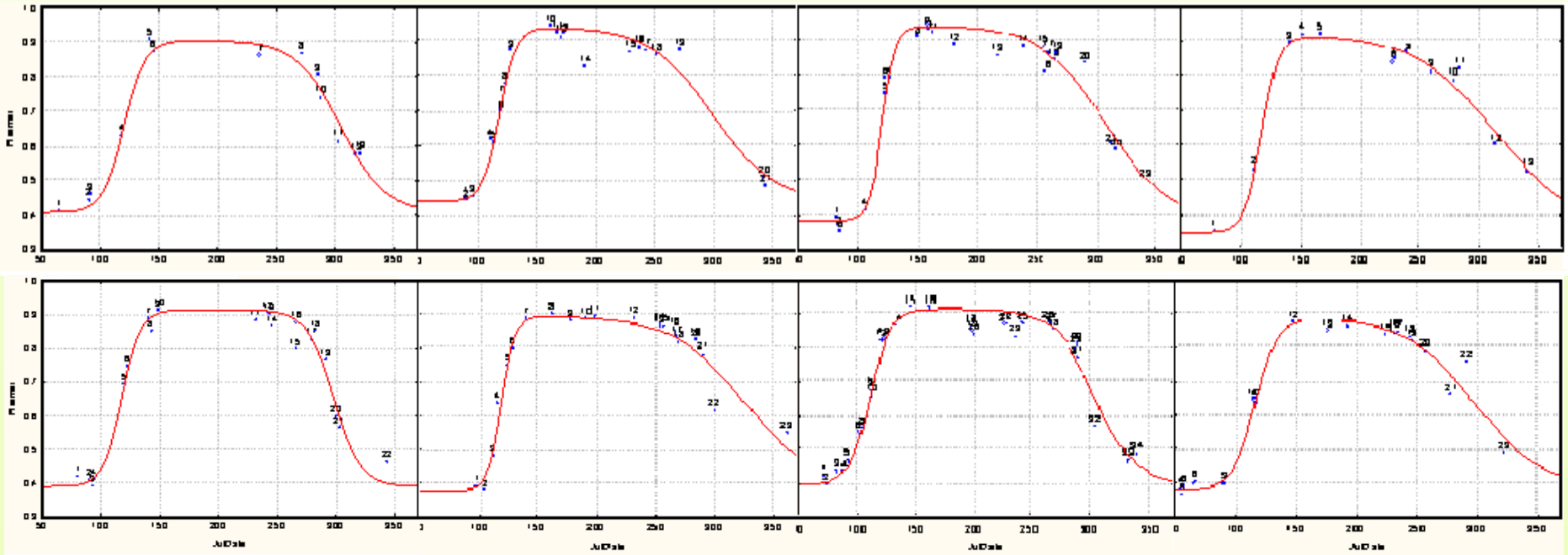
Phenological profile is approximated by function $f(t) = V_{min} + V_{amp}\left(\frac{1}{1+e^{m_1-n_1 t}} - \frac{1}{1+e^{m_2-n_2 t}}\right)$

where V_{min}, V_{amp}, m_1, n_1, m_2, n_2 are appropriate parameters.

Its first derivative is equal to $f'(t) = V_{amp}\left(\frac{n_1 . e^{m_1-n_1 t}}{(1+e^{m_1-n_1 t})^2} - \frac{n_2 . e^{m_2-n_2 t}}{(1+e^{m_2-n_2 t})^2}\right)$

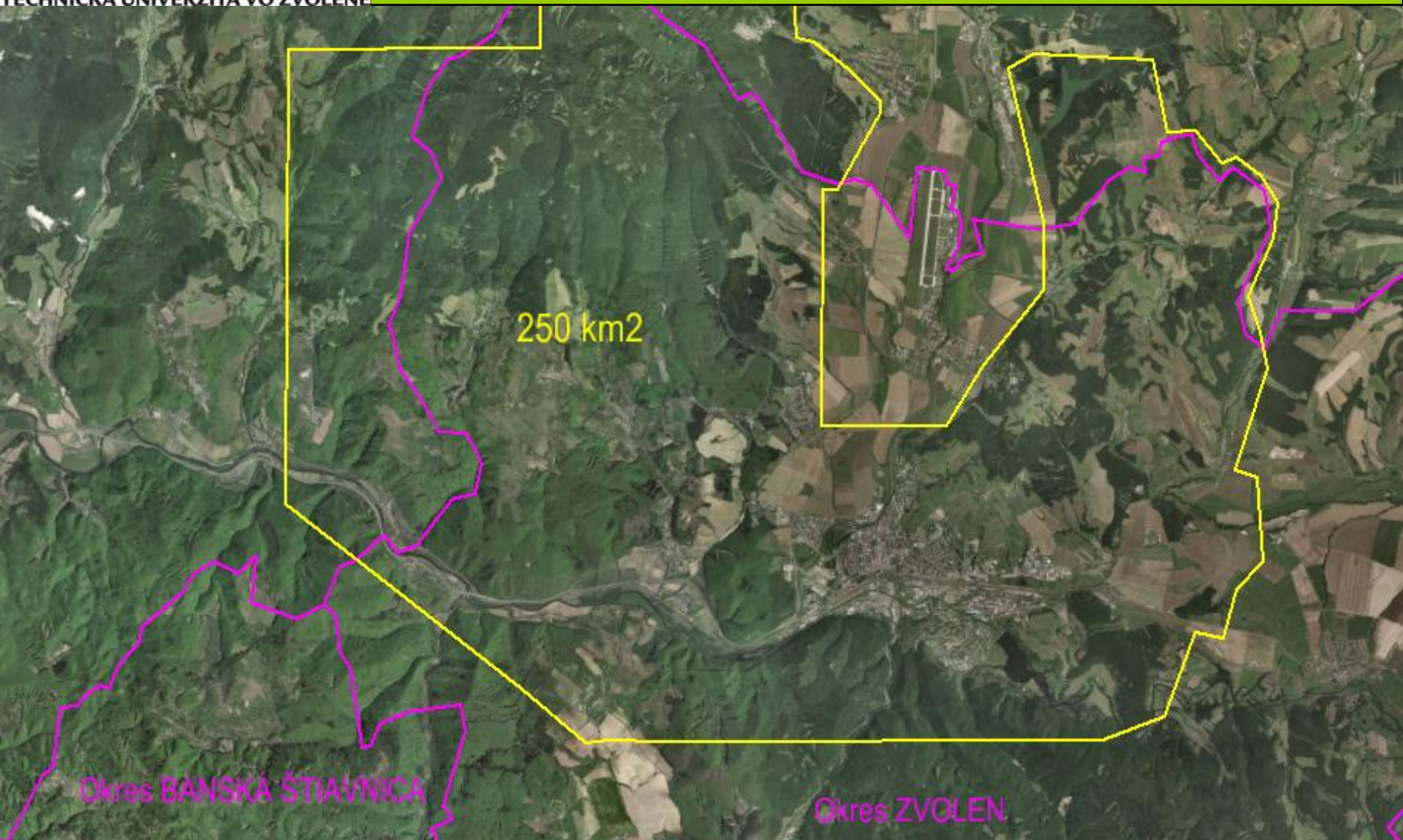
and second derivative to $f''(t) = V_{amp}\left(\frac{n_1^2 . e^{2m_1-2n_1 t} . (1-e^{m_1-n_1 t})}{(1+e^{m_1-n_1 t})^3} - \frac{n_2^2 . e^{2m_2-2n_2 t} . (1-e^{m_2-n_2 t})}{(1+e^{m_2-n_2 t})^3}\right)$

Priebehy krivky NDVI v rokoch 2001-2008: Čiáre, Quercus cerris



TECHNICKÁ UNIVERZITA VO ZVOLENE

Technical University of Zvolen

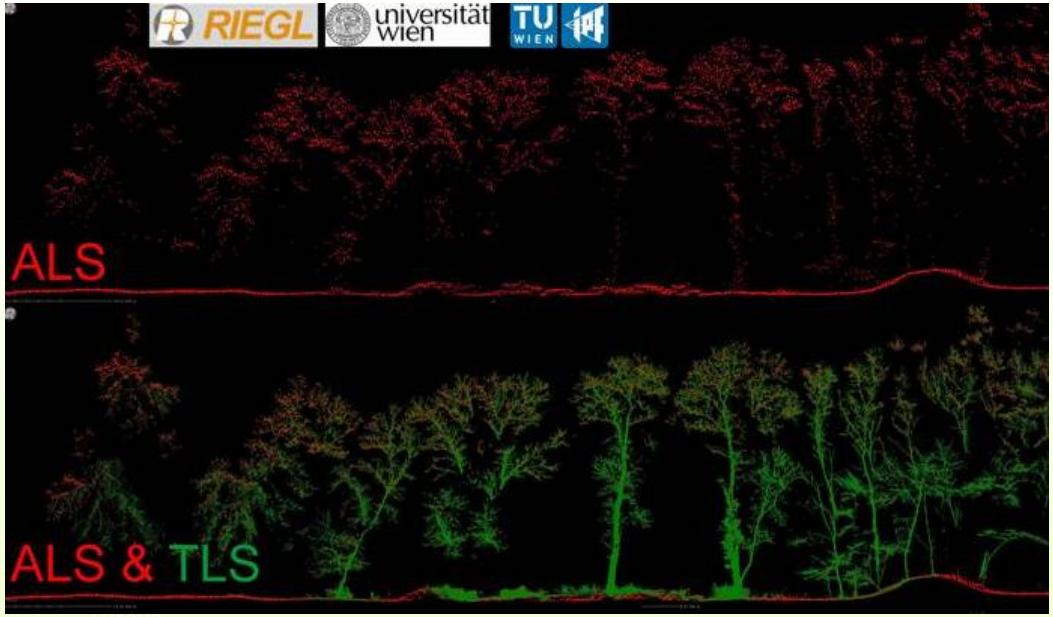


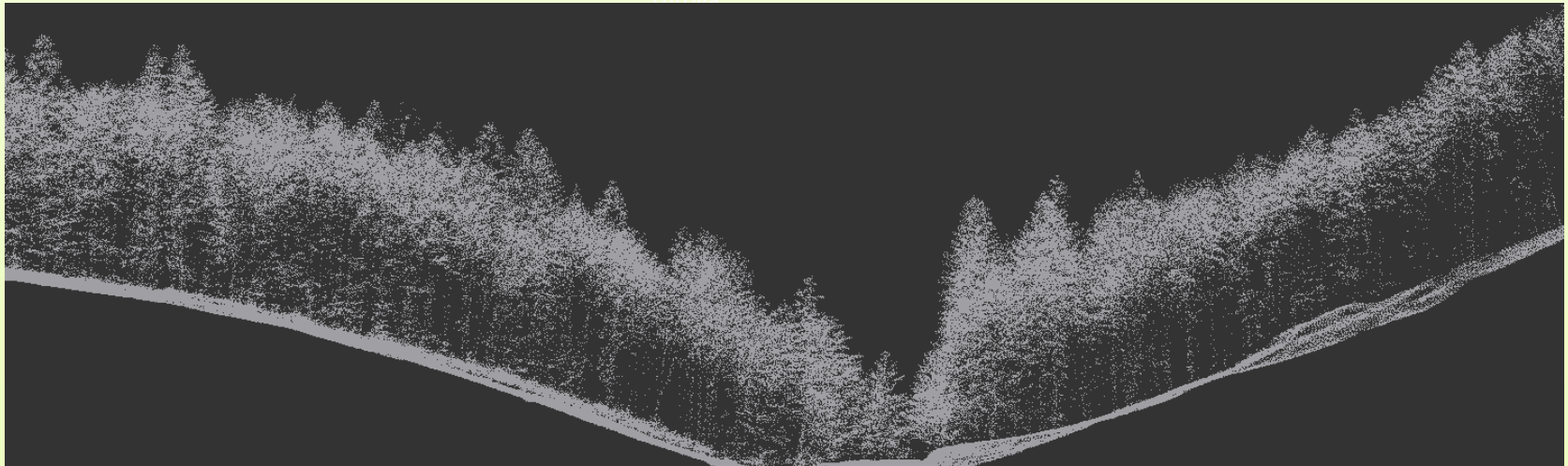
TECHNICKÁ UNIVERZITA VO ZVOLENE

Airborne hyperspectral imagining

TECHNICKÁ UNIVERZITA VO ZVOLENE

LIDAR research





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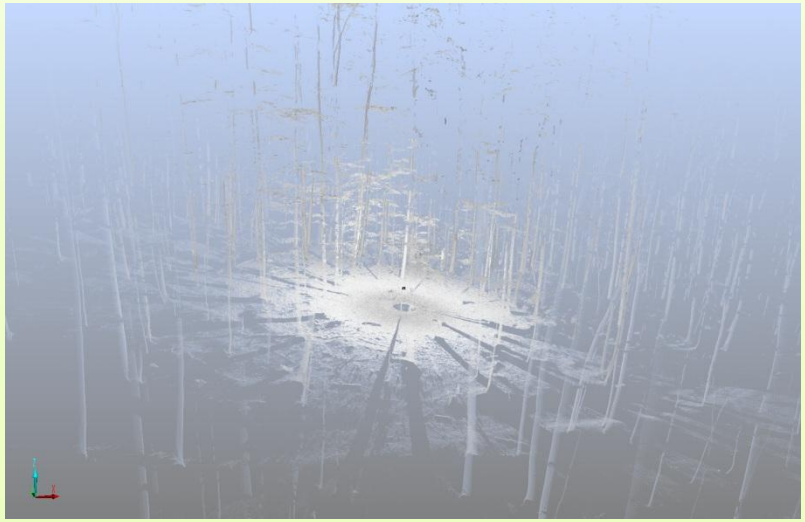
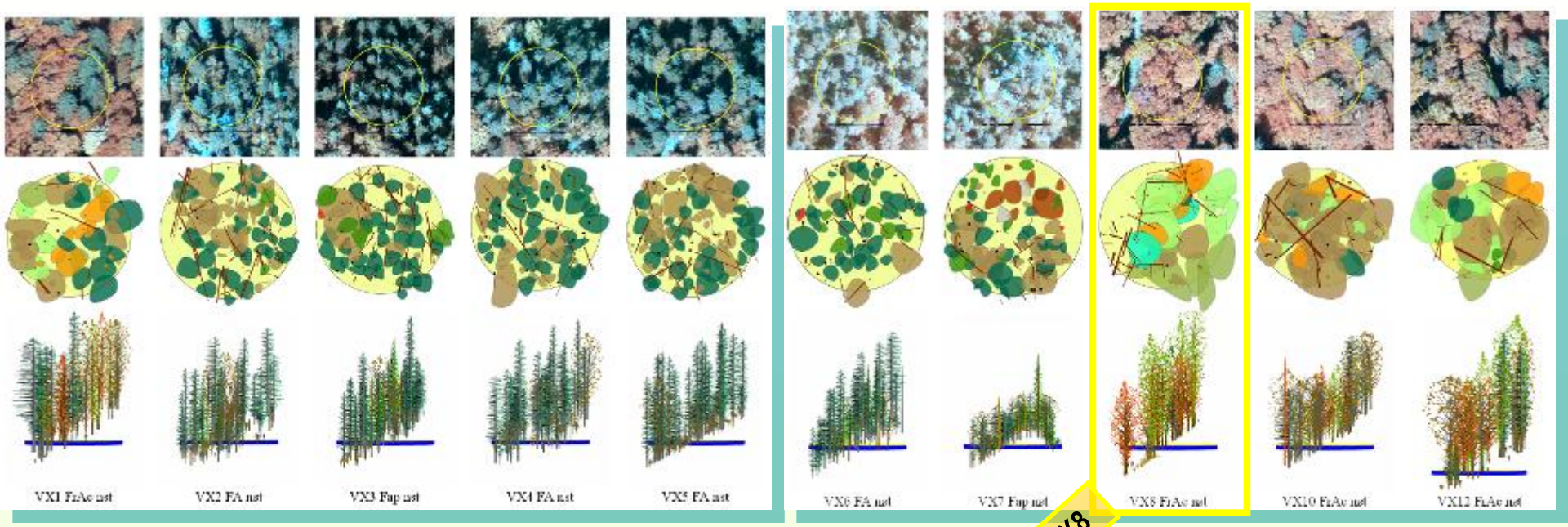
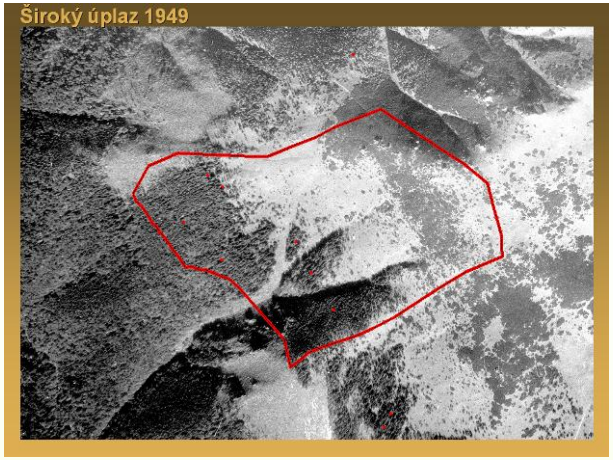
Terrestrial laser scanning

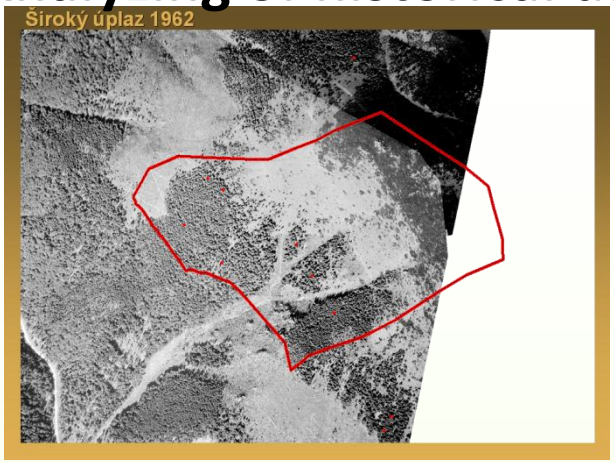


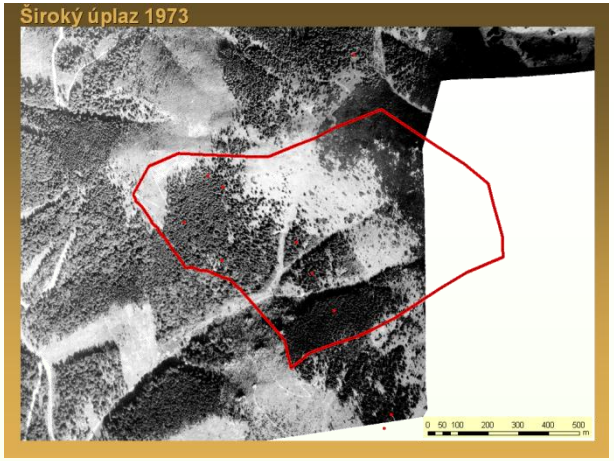
Texture and structure of forest stands analyzed by FieldMap

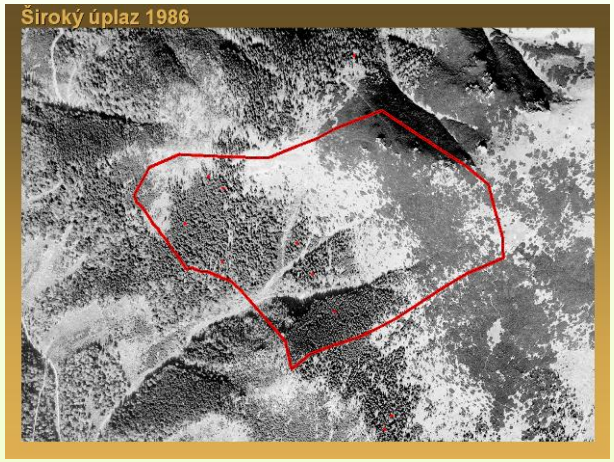


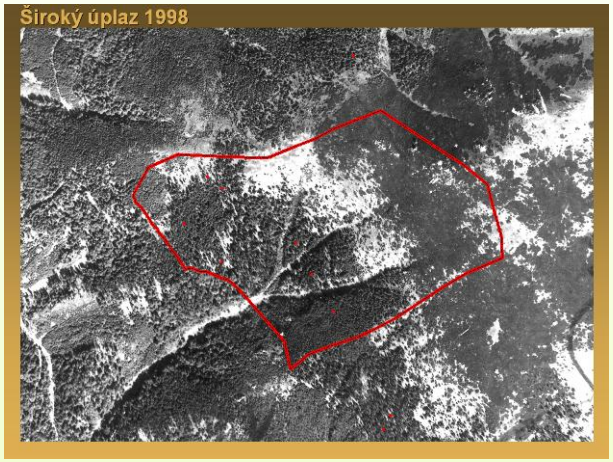
Analyzing of historical data

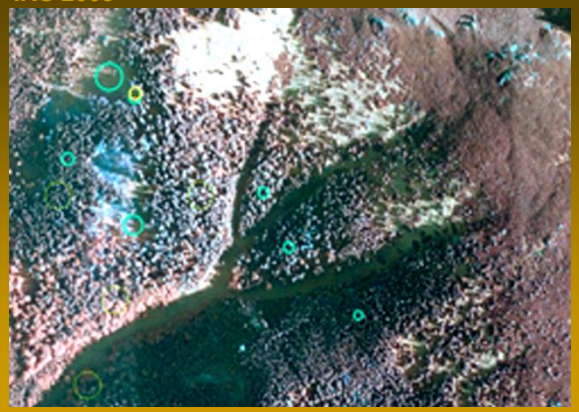


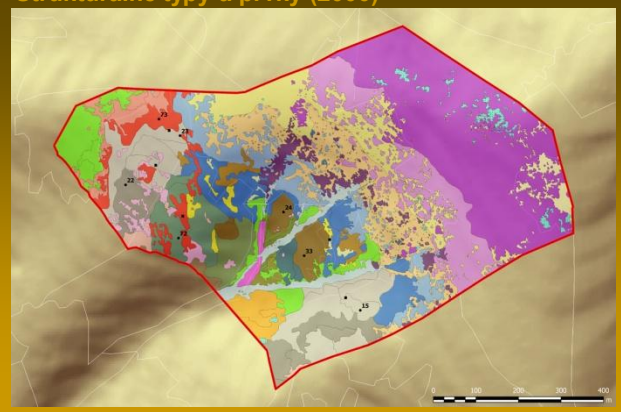


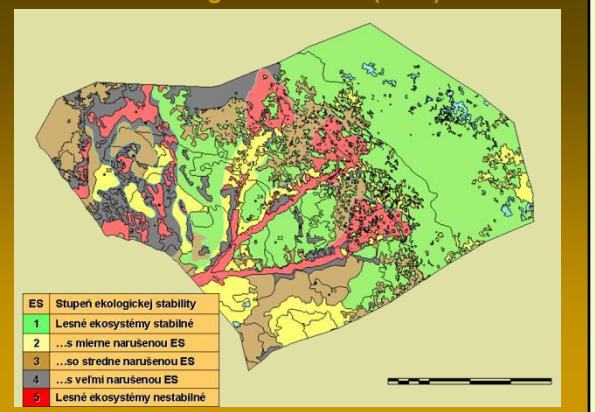




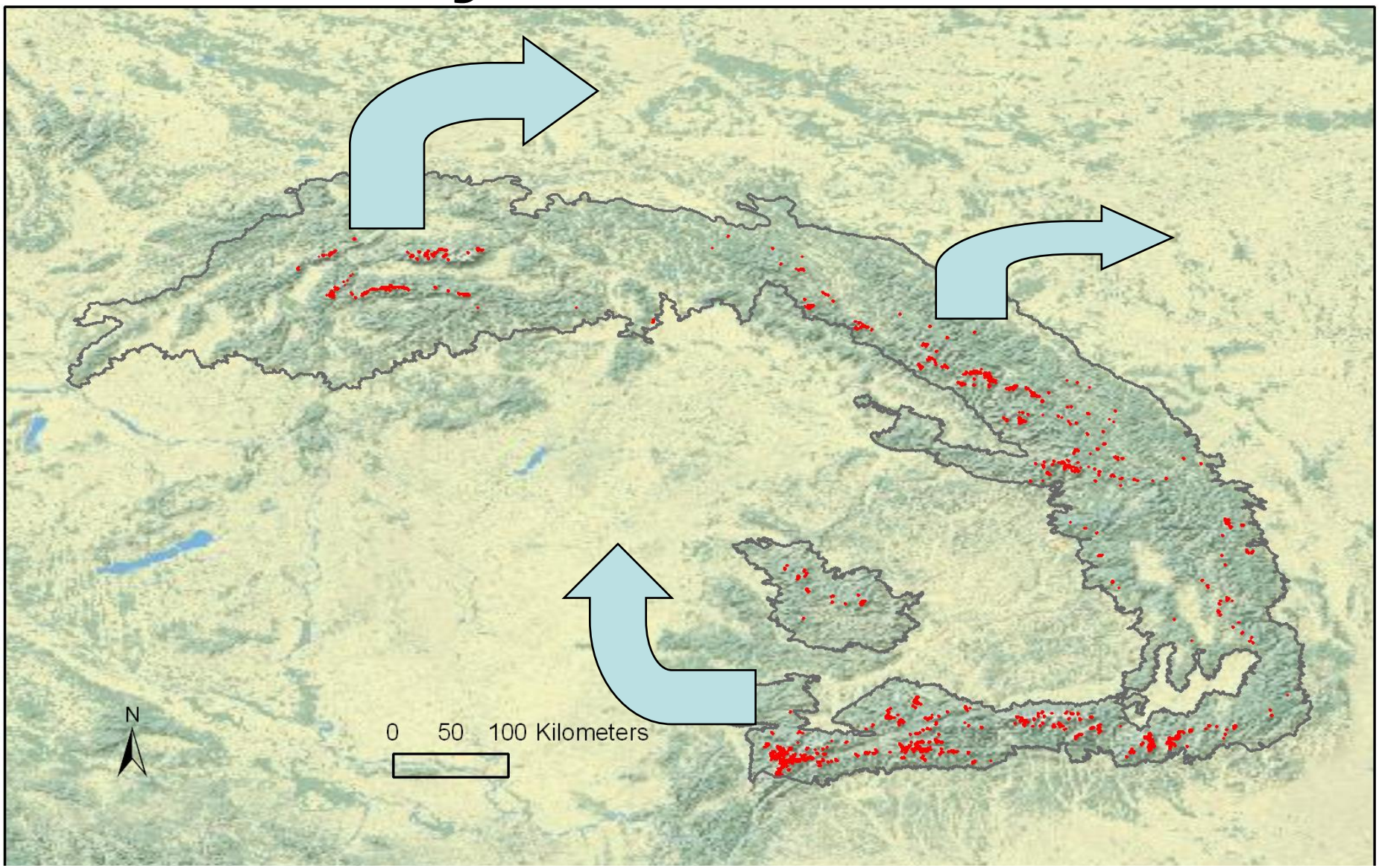








Thank you for attention!



Lets spread out your knowledge!