AUTOMATIC IMAGE PROCESSING FOR LAND COVER MAPPING AND DROUGHT MONITORING

Tatjana Veljanovski
ZRC SAZU

SCERIN-6 Capacity Building Workshop
on Earth System Observations
Zagreb, 12-06-2018

DETERMINING THE LAND COVER

Automatic land cover classification

Land cover change

ESA PECS project

Objectives

- ESA PECS project: 2015-2017
- an accurate, countrywide, harmonized land information system that covers present and future needs of its users in Slovenia
- based on EO data, VHR and HR
- designed for straightforward continuous updating
- efficient classification

- Land Information System Slovenia (LISS)
- adaptation of LISA data model:
  - better compatibility to EU-wide harmonized data sets

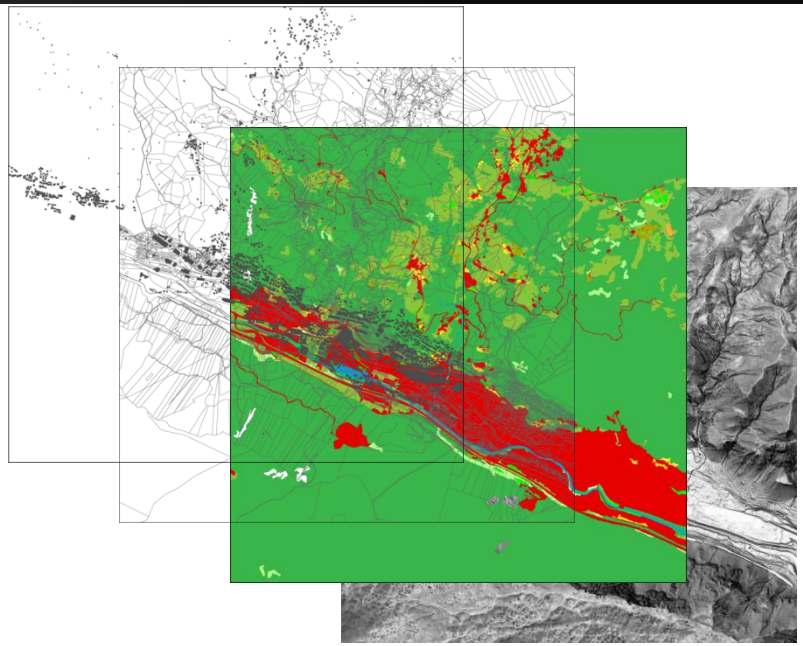
Izola: RABA, MKGP, 2016

25 categories of mixed land use and land cover
manual, based on aerial imagery
1 per 3 years
very good spatial resolution and thematic accuracy

0 1000 m

Auxiliary and satellite data

- Auxiliary data:
  - topographic data
  - land use/land cover data
  - cadastral data
  - aerial orthophotos
- Satellite data
  - **WorldView-2** (0.5 m)
  - **Pleiades** (0.5 m)
  - **SPOT 6, 7** (1.5 m)
  - RapidEye (6.5 m)
  - **Sentinel-2** (10/20/60 m)
  - THEOS (15 m)
  - Landsat 4-8 (30 m)
  - PROBA-V (100 m)



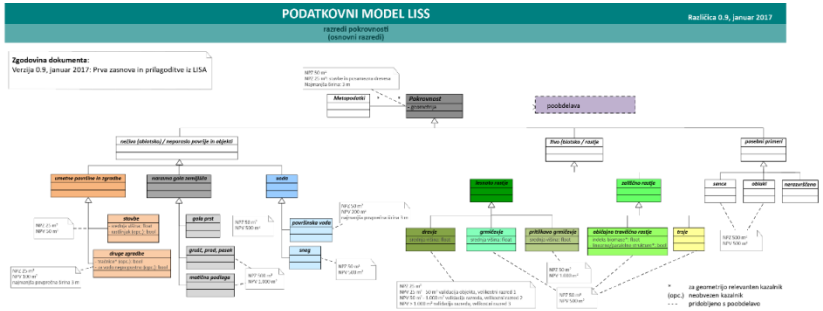
LISS data model, adaptations

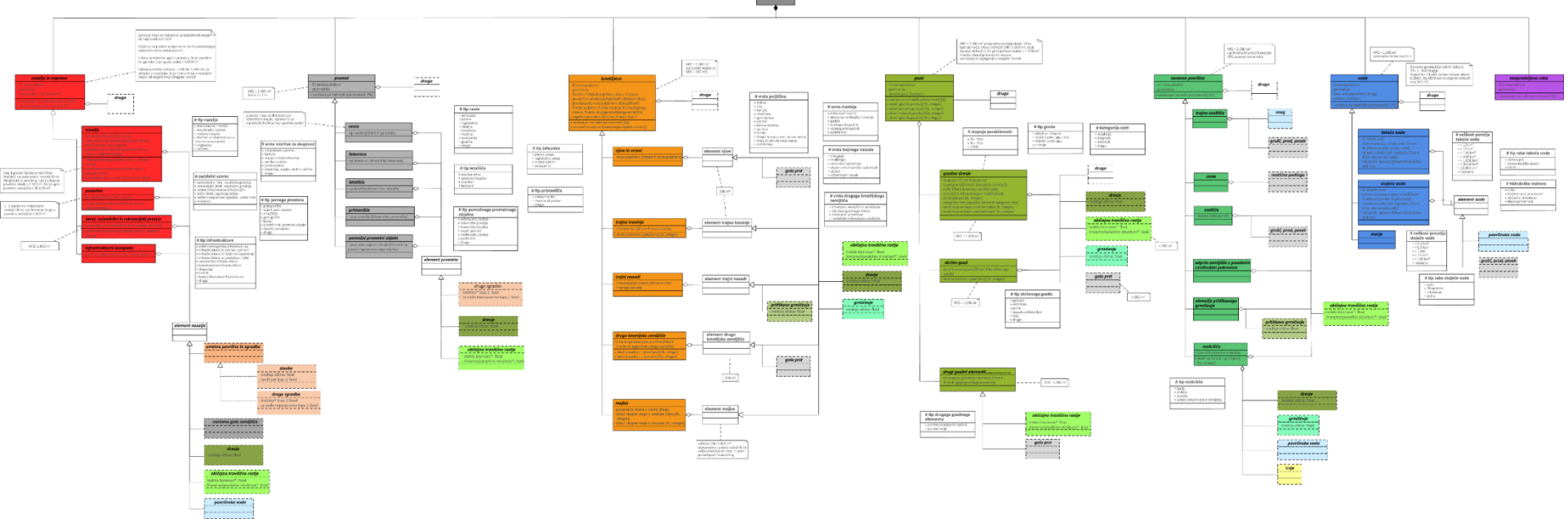
- adapted to the need of Slovenian users
- adapted to the specifics of Slovenian landscape
- adapted for use with HR and VHR satellite images

- **land cover (LC)** data model
  - minimal changes, 12 classes + 3 uninterpretable

- **land use (LU)** data model
  - adapted in a number of details (classes, attributes, attributes codings)

LISS data model





Nearly fully automatic LC classification

RABA
Actual land use of agricultural and forest land

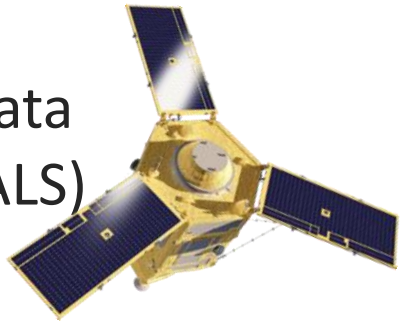
ZKGJI
Cumulative cadastre of public infrastructure

KS
Cadastre of buildings

classification scheme

Training samples

remote sensing data (satellite, aerial, ALS)



ASLAN tool
(Advanced Satellite Land cover ANalysis)
MACHINE LEARNING

land cover

LISS LC

- nearly fully automatic
- 1 per month or as necessary
- lower spatial resolution

SPOT7, 1.5 m, 22.08.2015

Level 3

- building
- other constructed area
- bare soil
- screes
- surface water
- trees
- bushes
- dwarf shrubs
- herbaceous vegetation

0 1000 m

LC information layer

Pleiades, 1.0 m, 2.8.2013

Level 3

- building
- other constructed area
- bare soil
- screes
- surface water
- trees
- bushes
- dwarf shrubs
- herbaceous vegetation

LC information layer

SPOT7, 1.5 m, 12.6.2014

Level 3

- building
- other constructed area
- bare soil
- screes
- surface water
- trees
- bushes
- dwarf shrubs
- herbaceous vegetation

Performance

- a variety of geographic regions

	MMU [m²]		Correctness [%]
	Pleiades	SPOT-6/7	(all images)
buildings	25	50	92
other constructed areas	25	50	70
bare soil	50	100	91
screes and bare rocks	50	100	68
surface water	50	100	92
woody vegetation	50	100	95
herbaceous vegetation	50	100	88
Average Overall Accuracy [%]			**86**

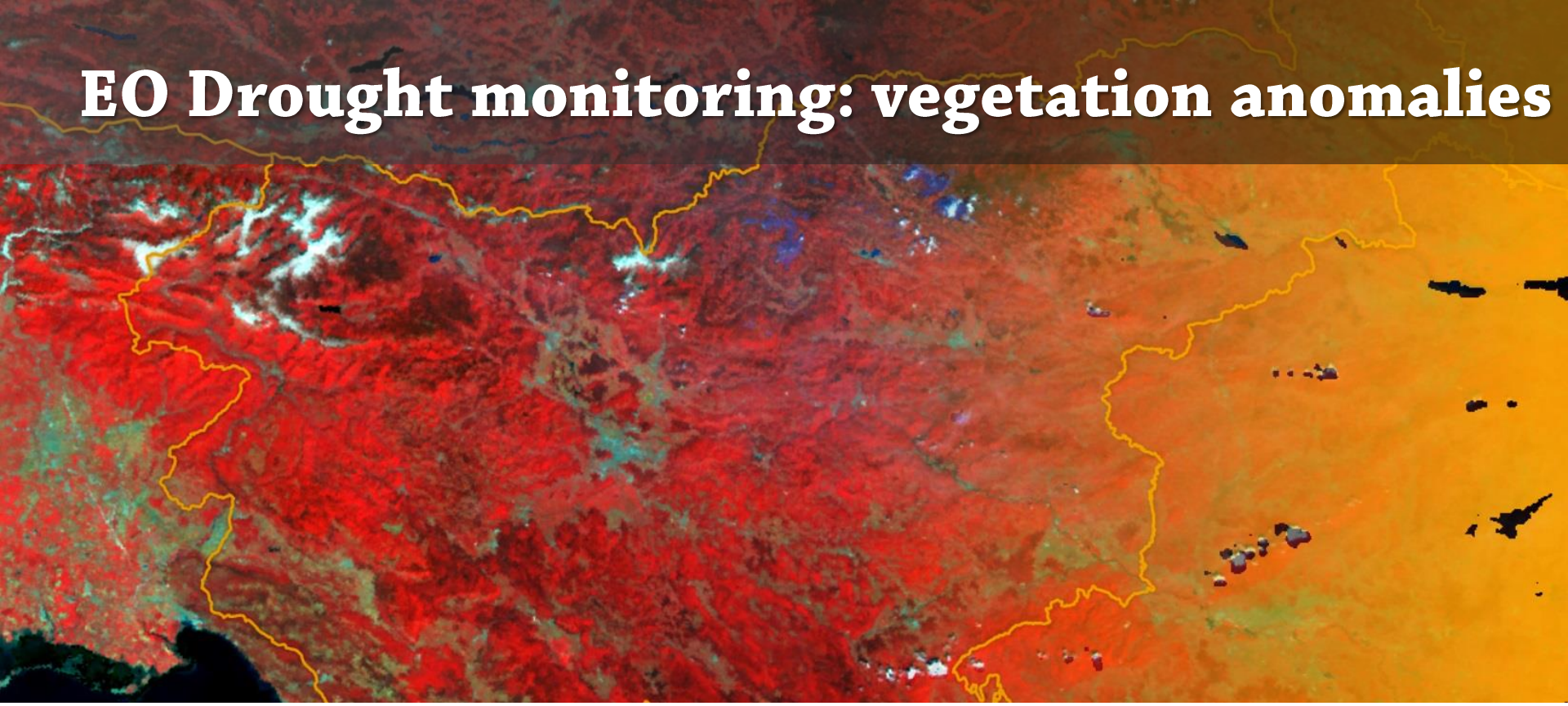
LC Future work

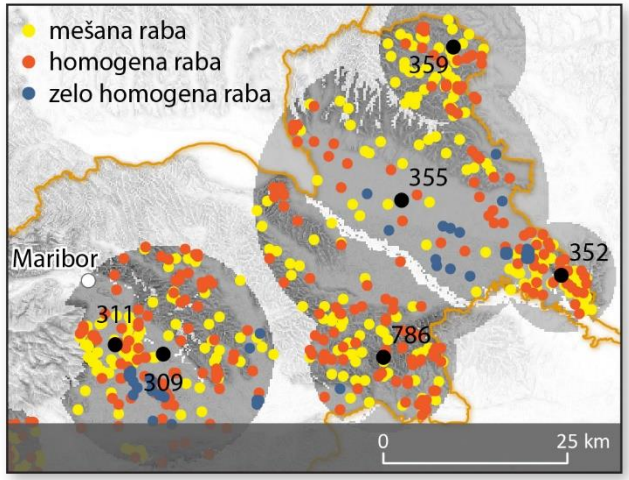
- integration of multi-temporal classification algorithms
- optimisation in large scale computation
- higher classification accuracy
- database of training samples
- a procedure for verification of results and integration into an official database

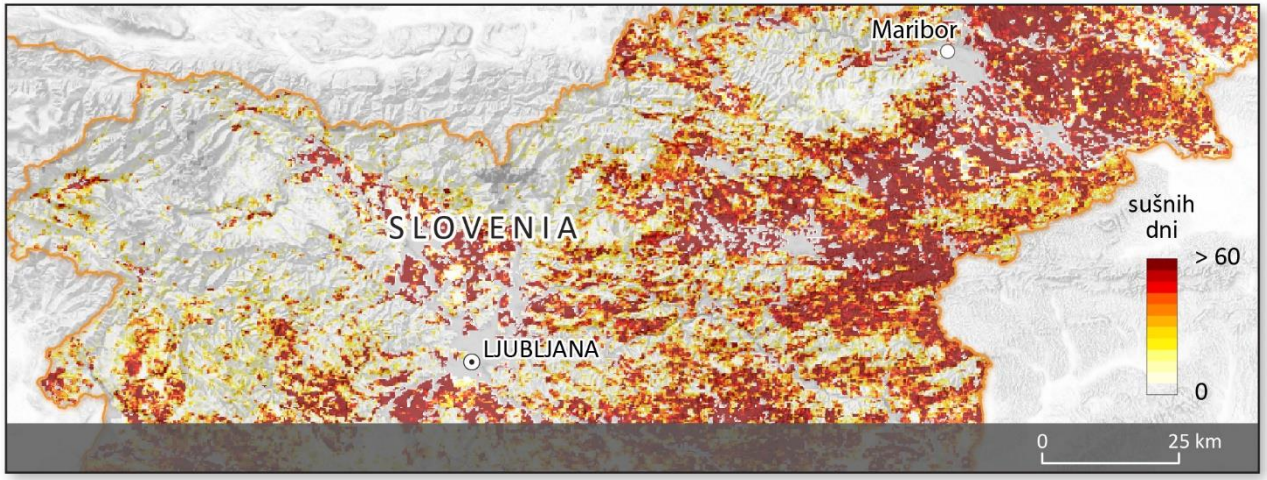
TOWARDS DROUGHT USER SERVICE

Detection of vegetation growth anomalies
Drought monitoring, prediction
Drought User Service
ESA PECS, Interreg DriDanube project

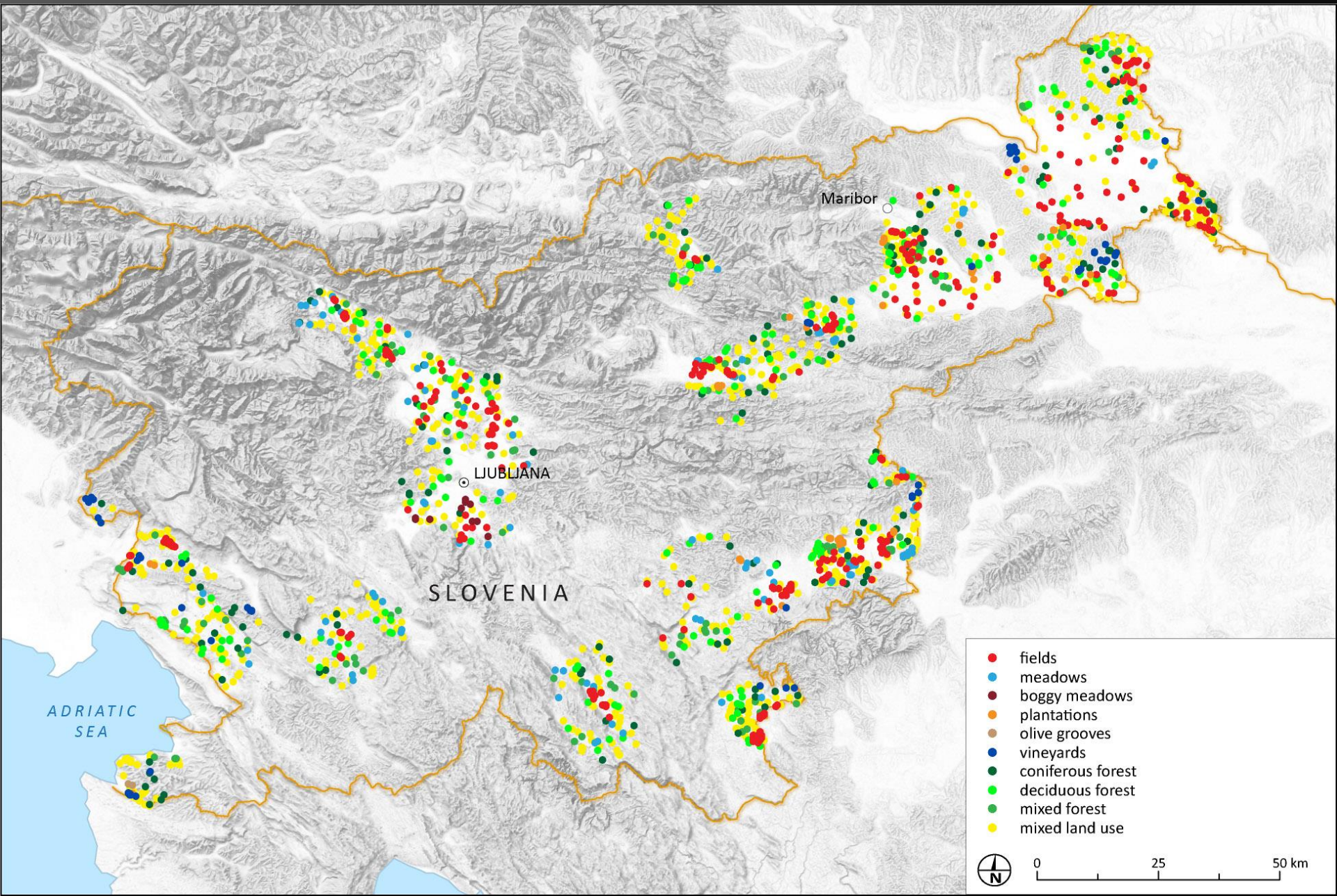
EO Drought monitoring: vegetation anomalies

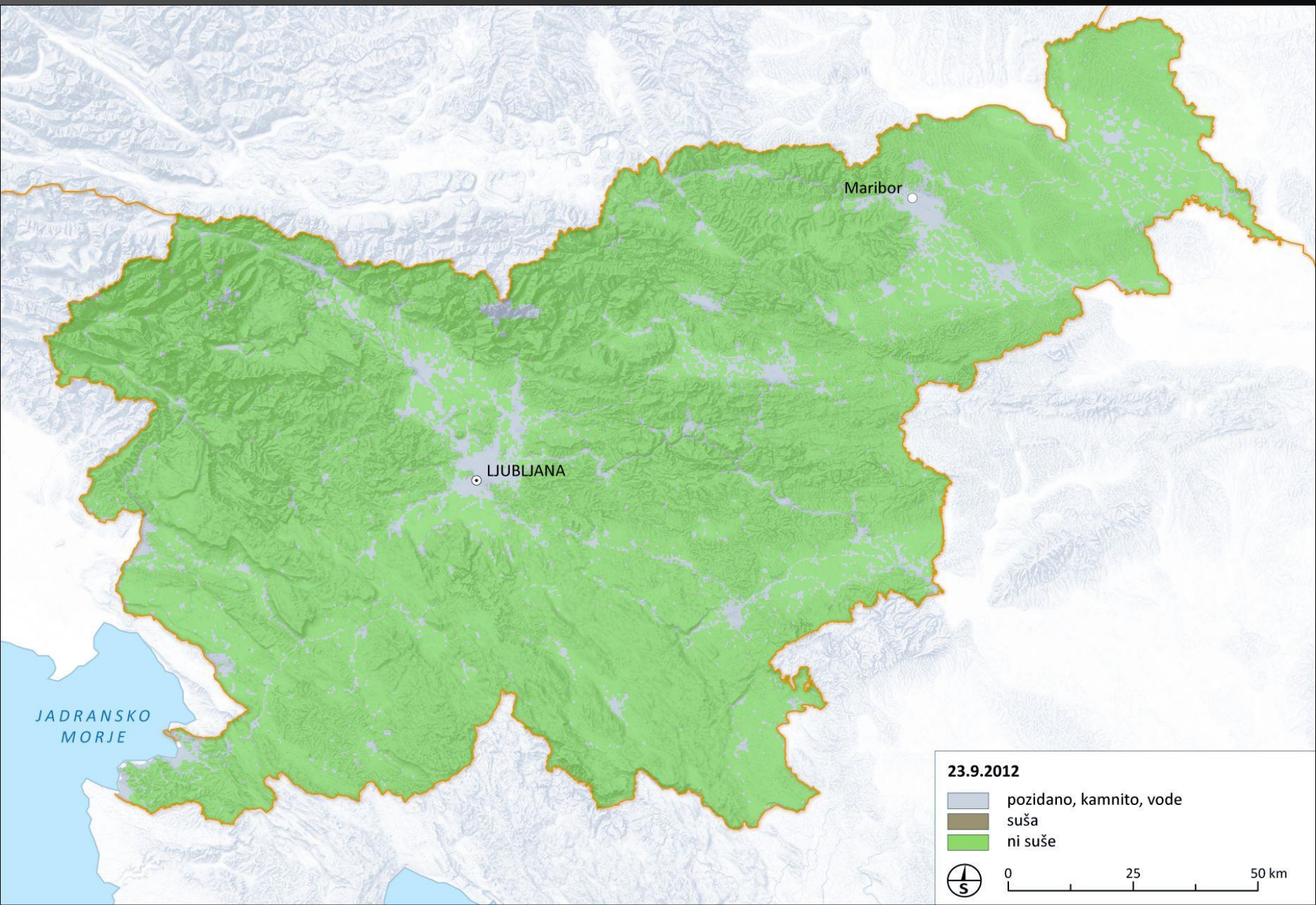




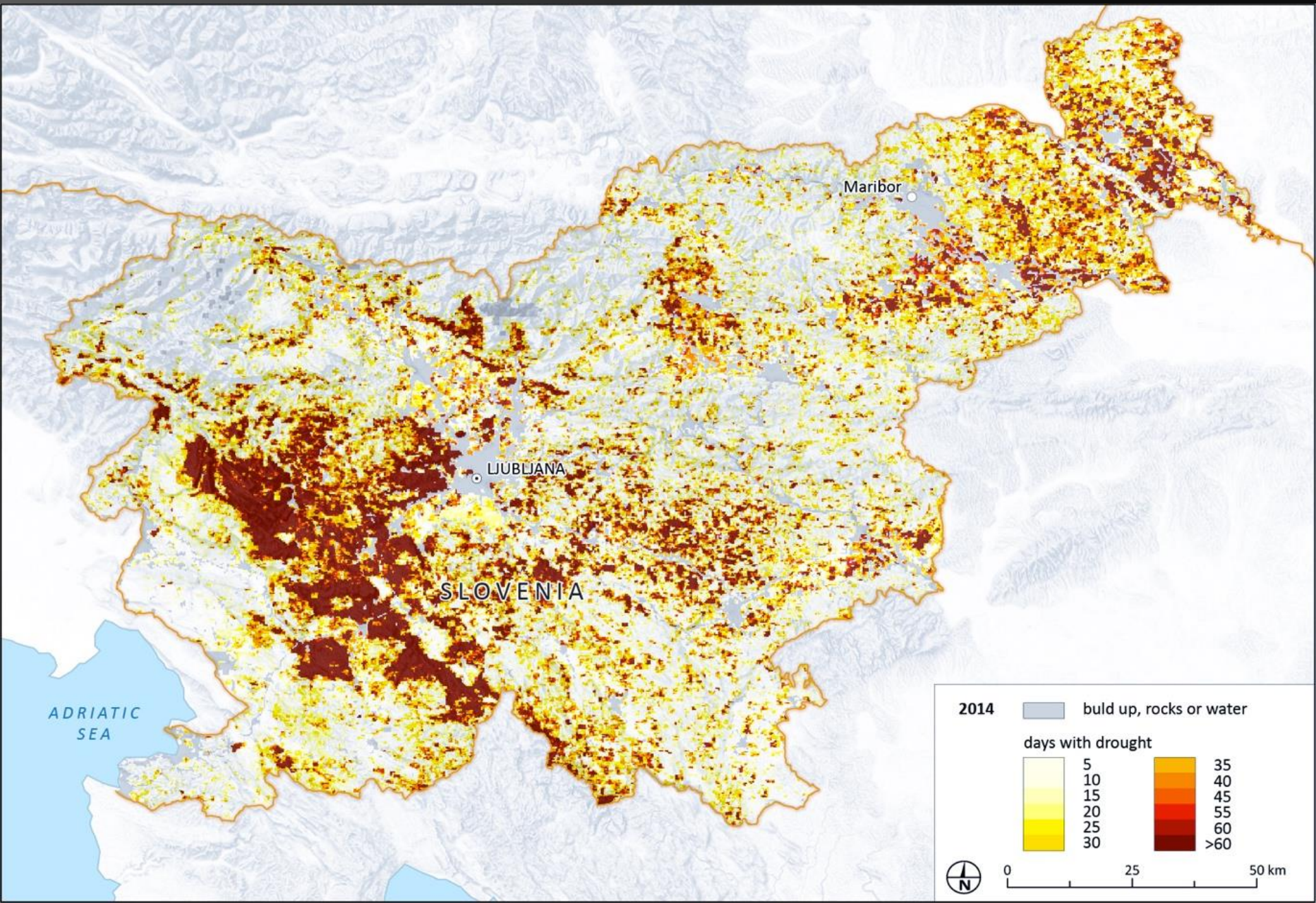


Ground measurement stations

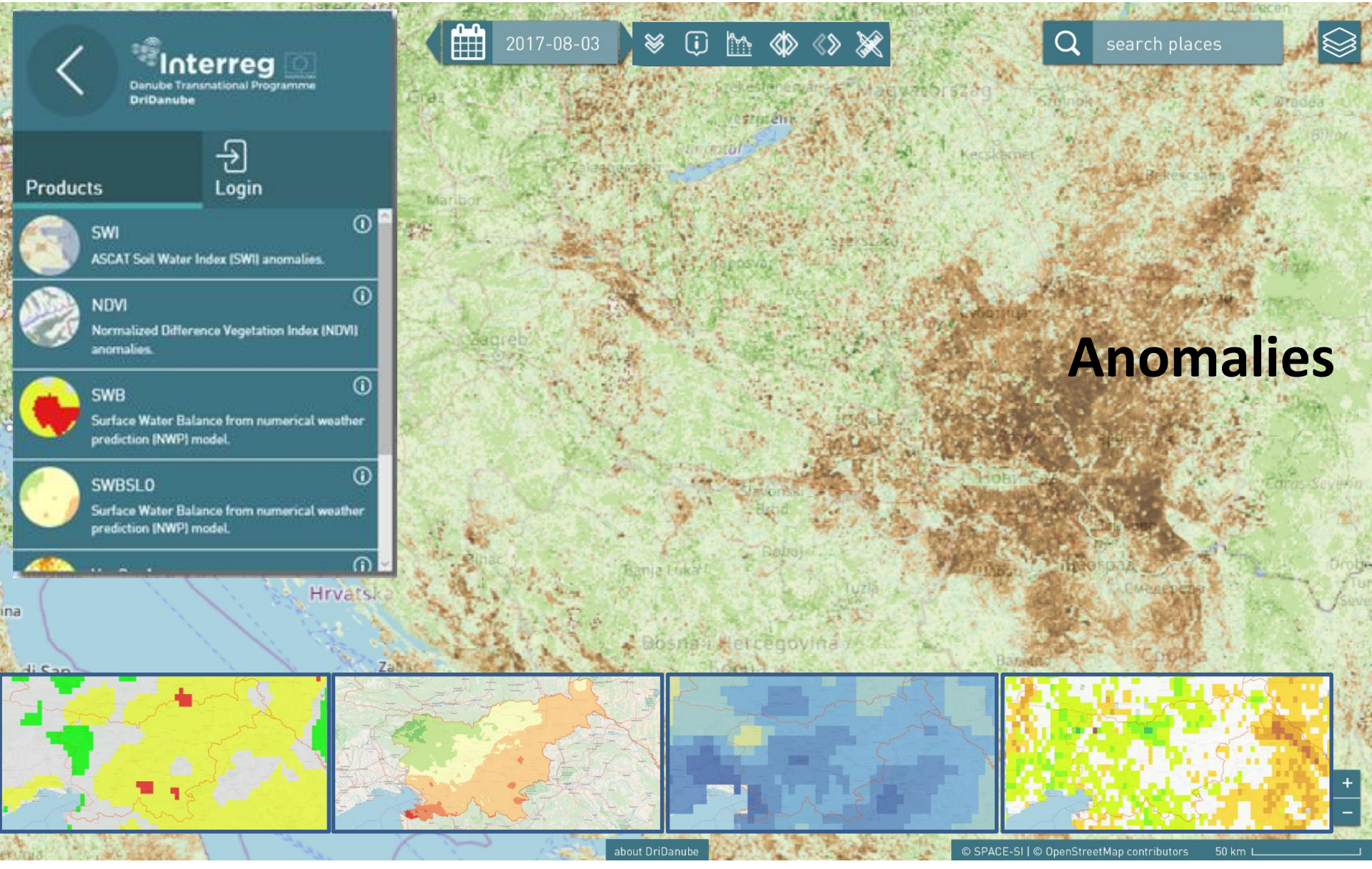



Maribor
LJUBLJANA
JADRANSKO MORJE
23.9.2012
pozidano, kamnito, vode
suša
ni suše
0
25
50 km

2006-2014


Maribor
LJUBLJANA
SLOVENIA
ADRIATIC SEA
2014
buld up, rocks or water
days with drought
5
10
15
20
25
30
35
40
45
55
60
>60
N
0
25
50 km

DriDanube: Drought related datasets viewer



Drought User Service

- ARSO (Slovenian Environment Agency)
- DMCSEE, Drought Management Centre for SE Europe:
  - Co-ordination, development, assessment and use of drought risk management tools and methods in SE Europe with the aim of improving the preparedness for drought and reducing its impacts
  - Tracing and predicting drought in SE region
  - Monthly reporting
- Pilot actions: Slovenia
  - Assessing the impact of drought
  - EO data and time series analysis framework
  - Monitoring drought: *when* and *where*, occurence patterns
  - Predicting *when*: drought announcement
  - MODIS products: 4/16 days composites, NDVI, EVI, LAI, FAPAR
  - ASCAT and Sentinel-2 data

RELEVANCE TO SCERIN

Relevance to SCERIN

Promote drought monitoring: Danube region ~ SCERIN region

or:

- multitemporal and multi-sensor data, time series applications in forestry, agriculture, land inventory
- multitemporal land cover classification
- multi-sensor data harmonisation

Fostering LC validation activities:

- development of database of training samples (SCERIN region)
- development database of reference data (SCERIN region)

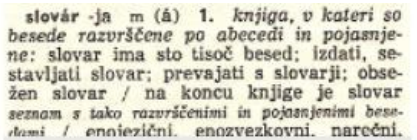
Contact

dr. Tatjana Veljanovski

tatjana.veljanovski@zrc-sazu.si

ZRC SAZU

Anton Melik Geographical Institute



Fran Ramovš Institute of the Slovenian Language

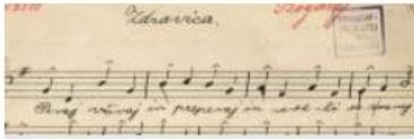
France Stele Institute of Art History

Institute of Anthropological and Spatial Studies

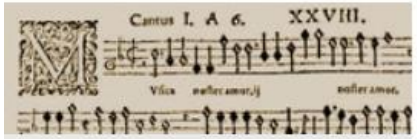
Institute of Archaeology

Institute of Cultural History

Institute of Culture and Memory Studies



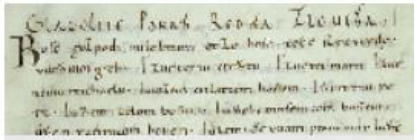
Institute of Ethnomusicology



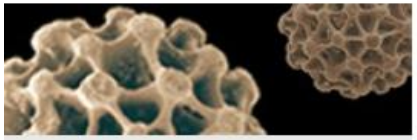
Institute of Musicology

Institute of Philosophy

Institute of Slovenian Ethnology



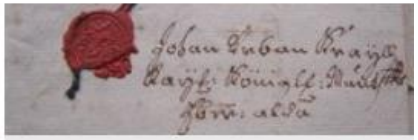
Institute of Slovenian Literature and Literary Studies



Ivan Rakovec Institute of Palaeontology

Jovan Hadži Institute of Biology

Karst Research Institute



Milko Kos Historical Institute

Slovenian Migration Institute

Sociomedical Institute

Remote Sensing Department

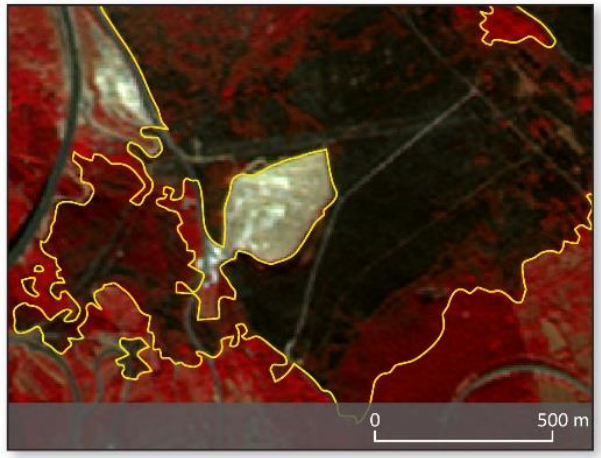
- 20 years of experience
- application, research and development
- GIS and remote sensing
- pioneering group
- automatic processing of optical satellite data, classification, change detection, spatial analyses and modelling, lidar data processing and visualization

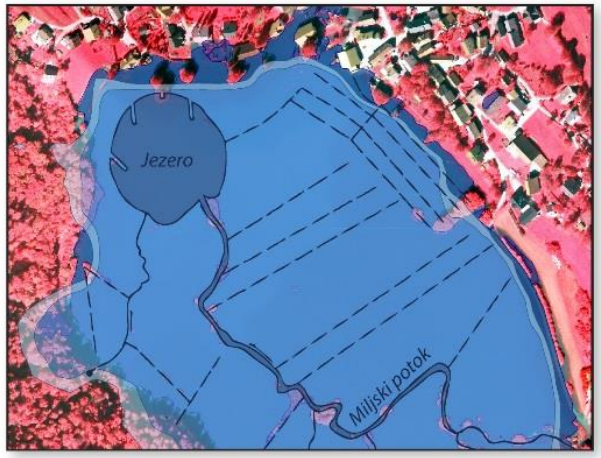
- our clients include the EU, World Bank, InterAmerican Development Bank, National Geographic Society, ESA, local and national authorities, museums, NGO's and commercial companies

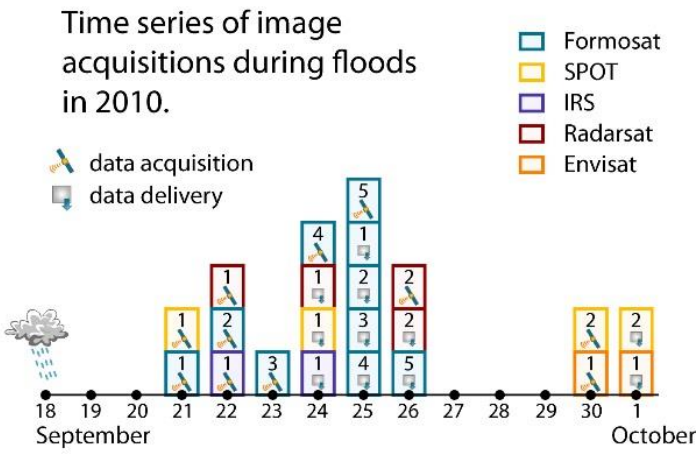
REMOTE SENSING APPLICATIONS

Providing fast, accurate and reliable thematic spatial data for efficient management of natural and built environments

Mapping the effects of major disasters

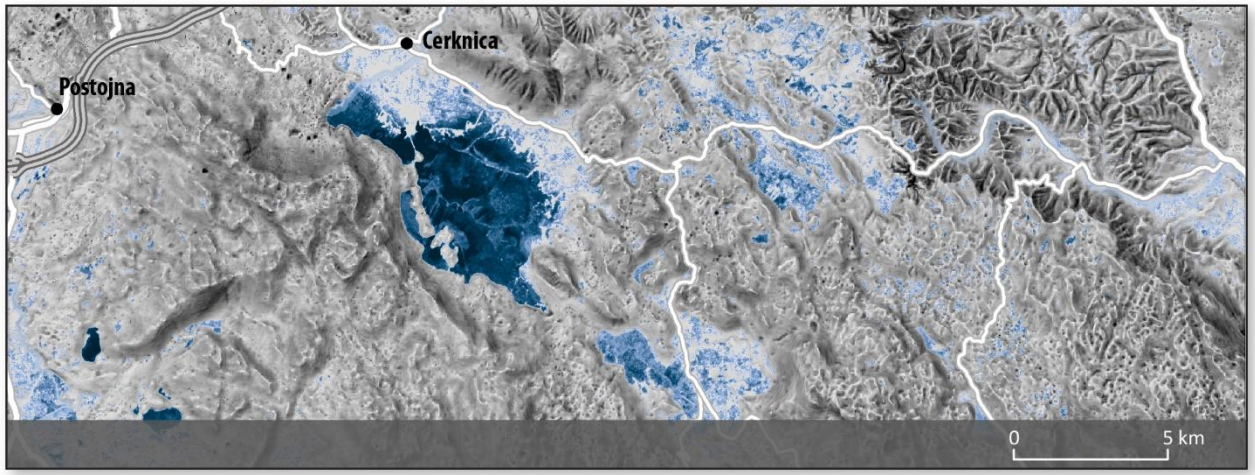




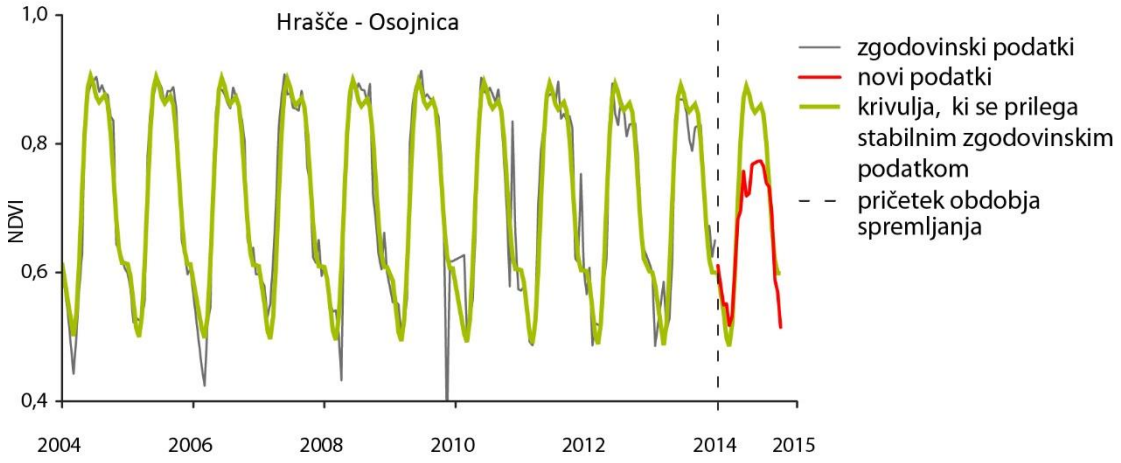


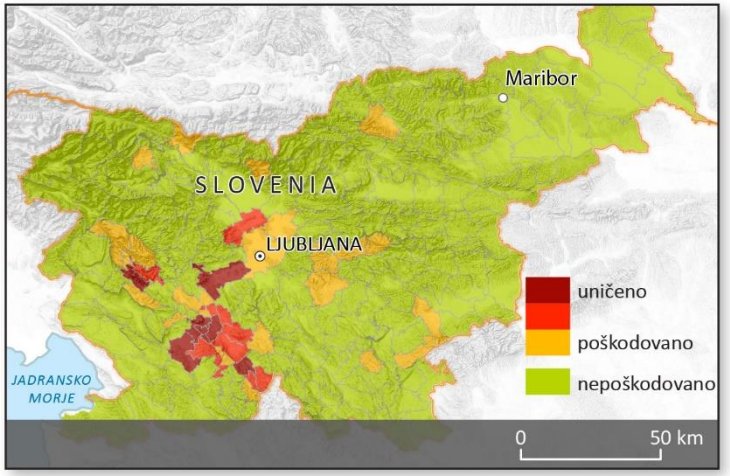
Water bodies mapping

Operational service

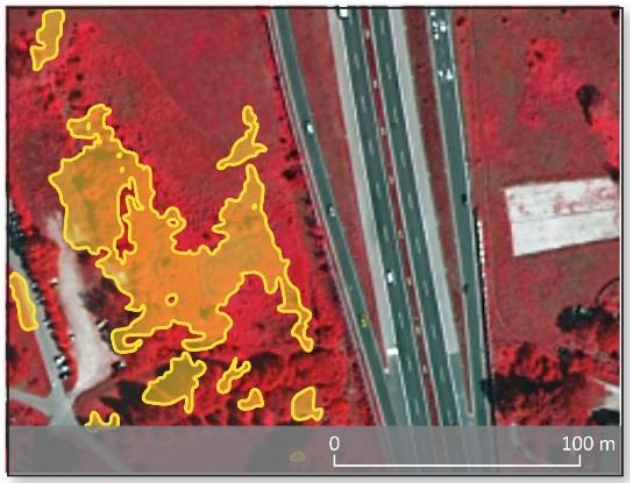


Monitoring forests

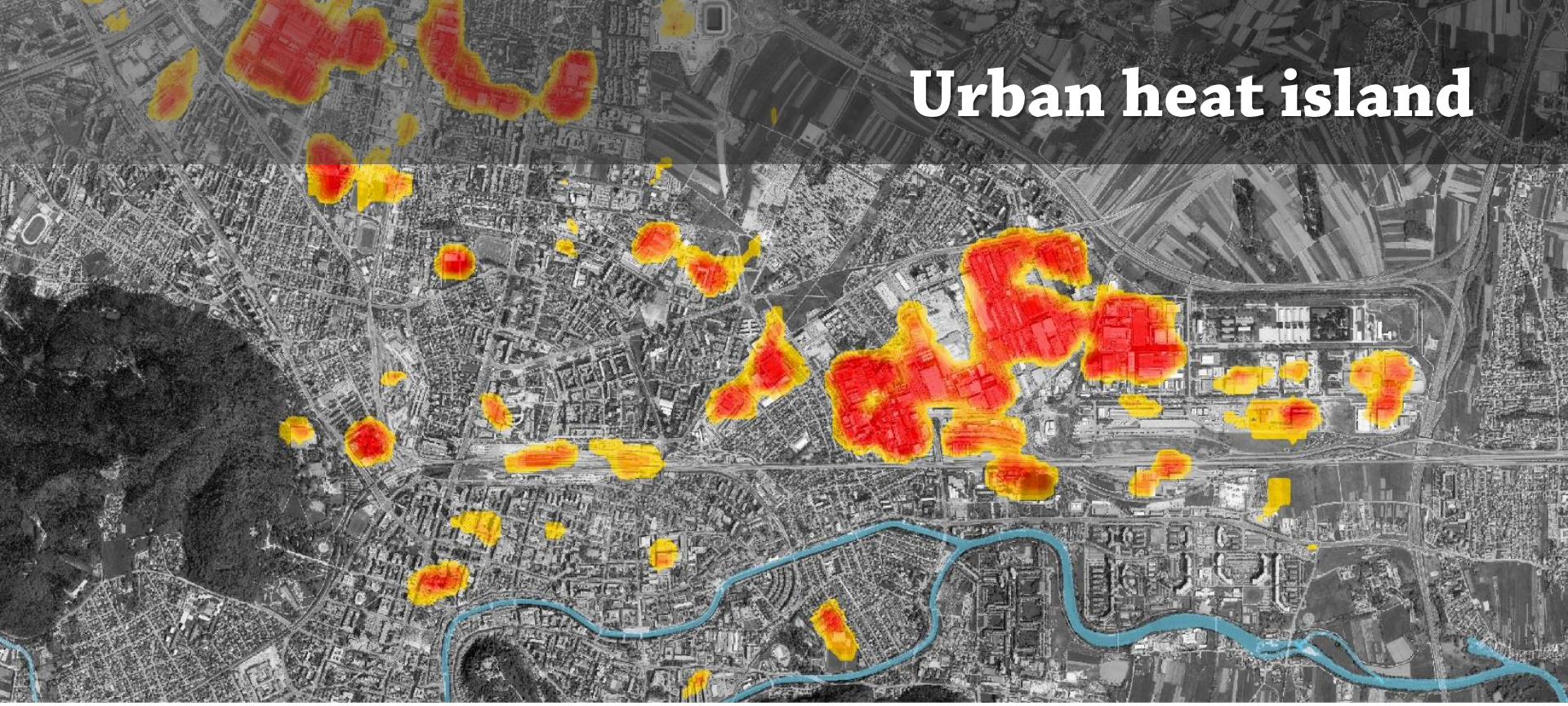


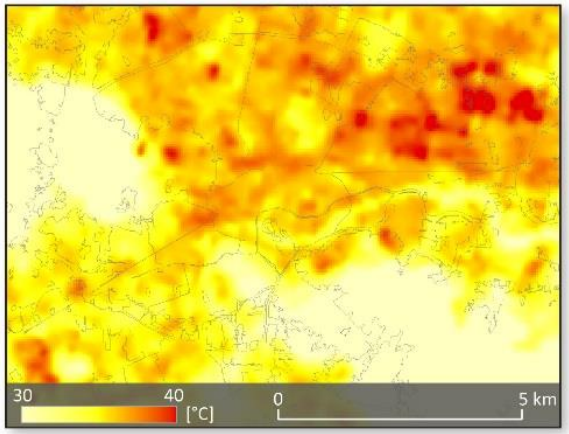


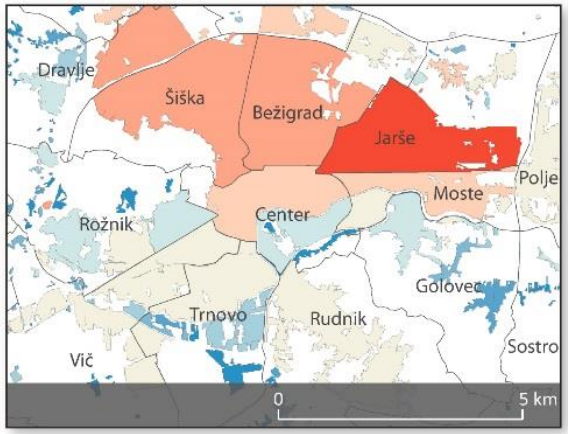
Monitoring invasive plants

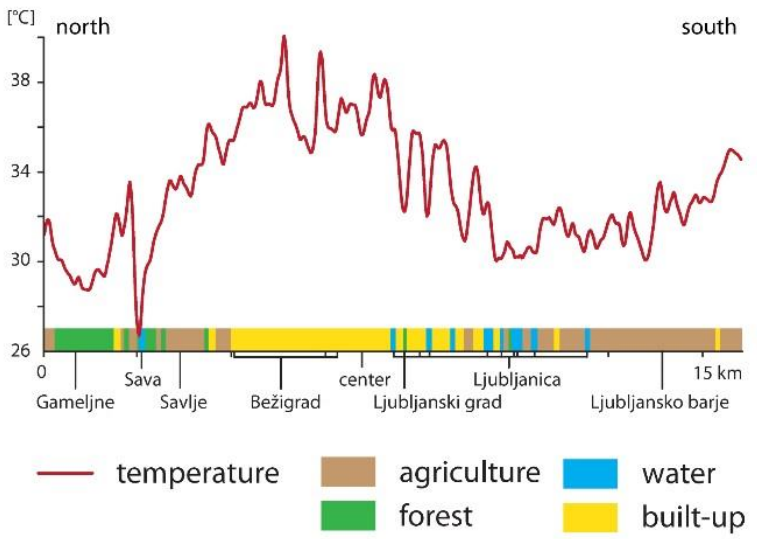


Urban heat island

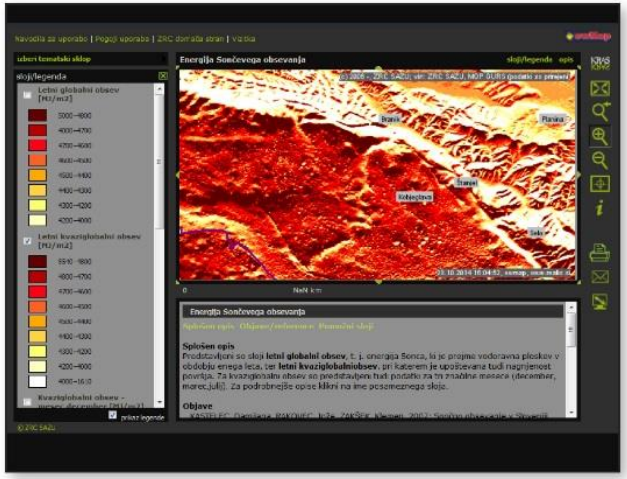


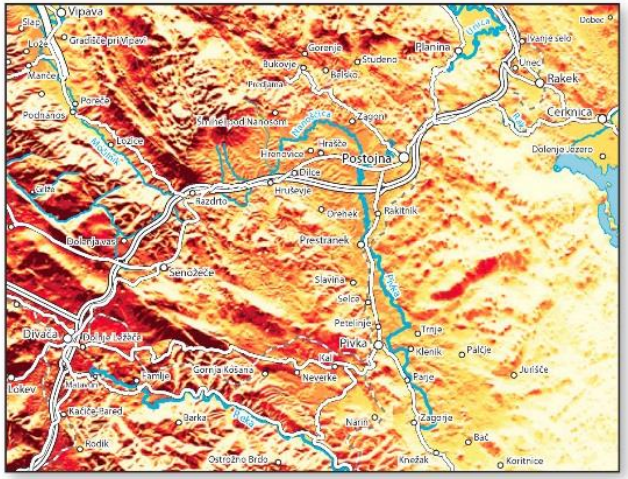






Solar insolation modelling

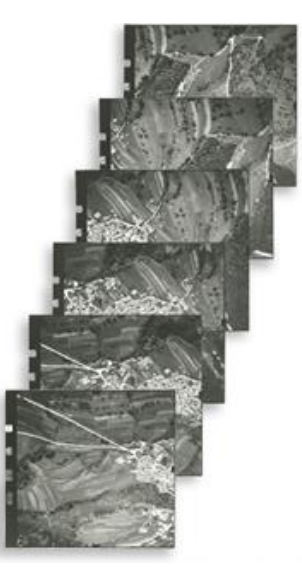


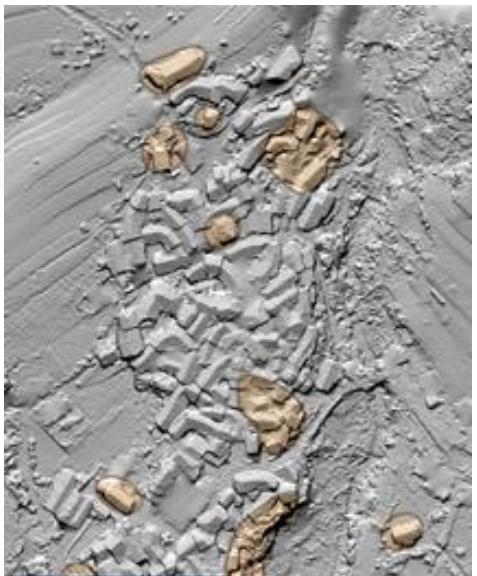


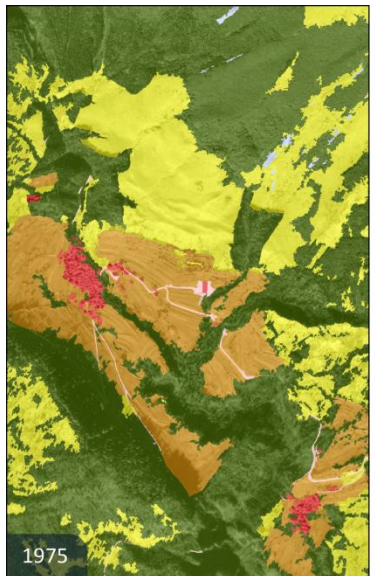
Analysis of historical landscapes

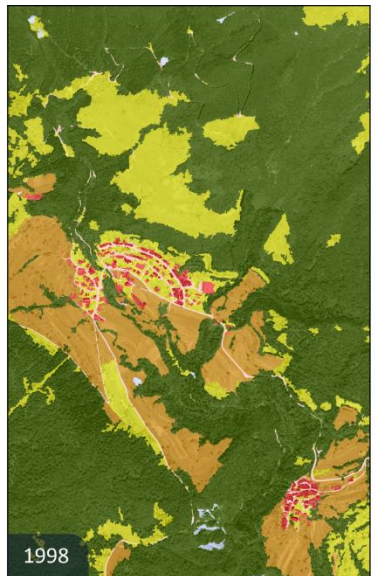
situation in 1976

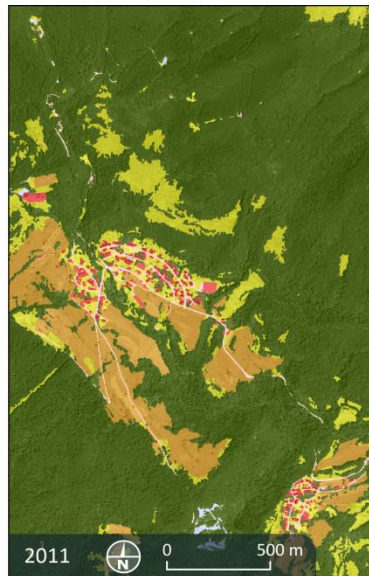
situation in 1977









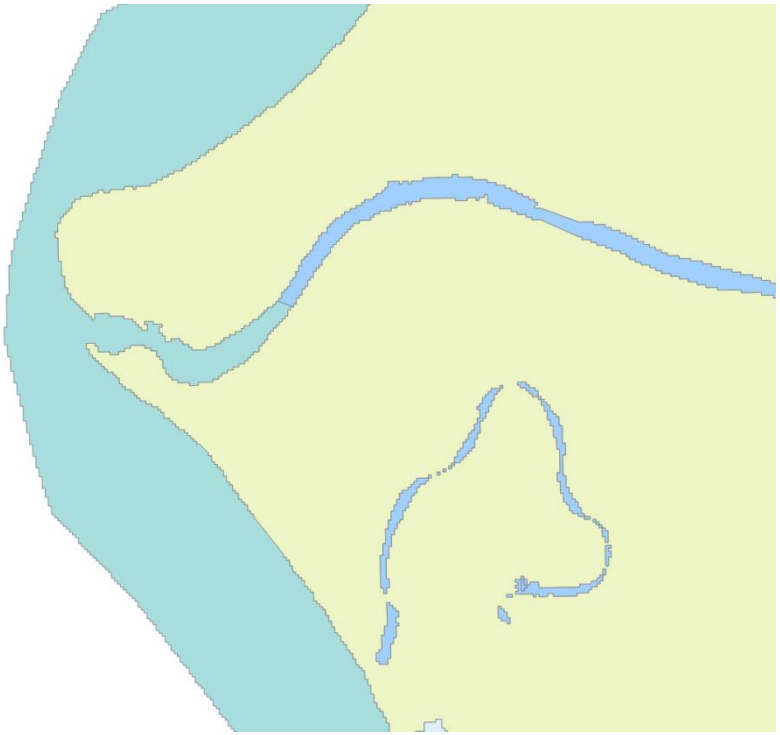


Long term changes in the landscape, Albania

Combination of anthropology and EO based spatial analysis

1984

Vlora estuary on a Landsat image

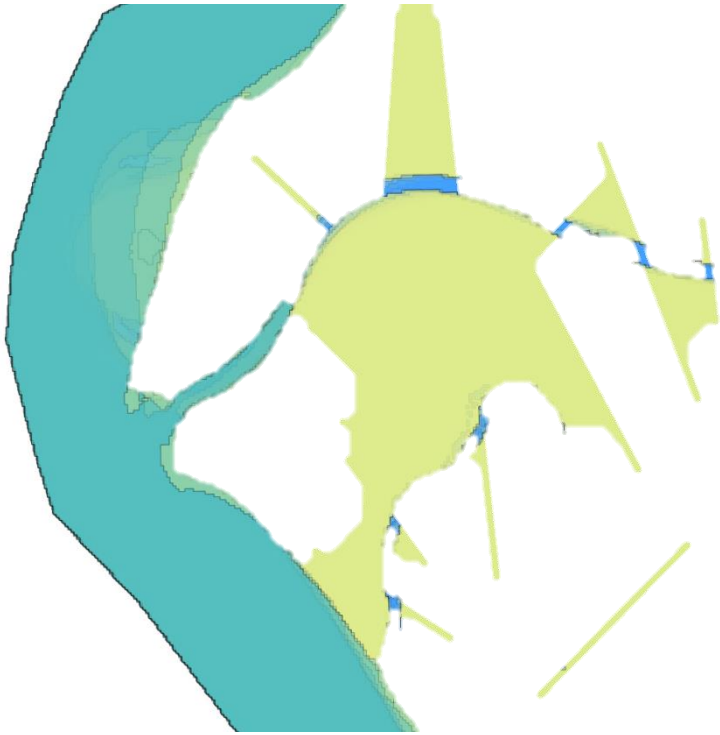


classification result

Long term changes in the landscape, Albania

2016

Vlora estuary on a Landsat image



results can be quantitatively assessed

STORM – processing chain

0. Integration of optical imagery
   (including metadata)

1. Geometric corrections
   (ortorectification)

2. Atmospheric correction
   Topographic correction

3. Products development
   (thematic processing)