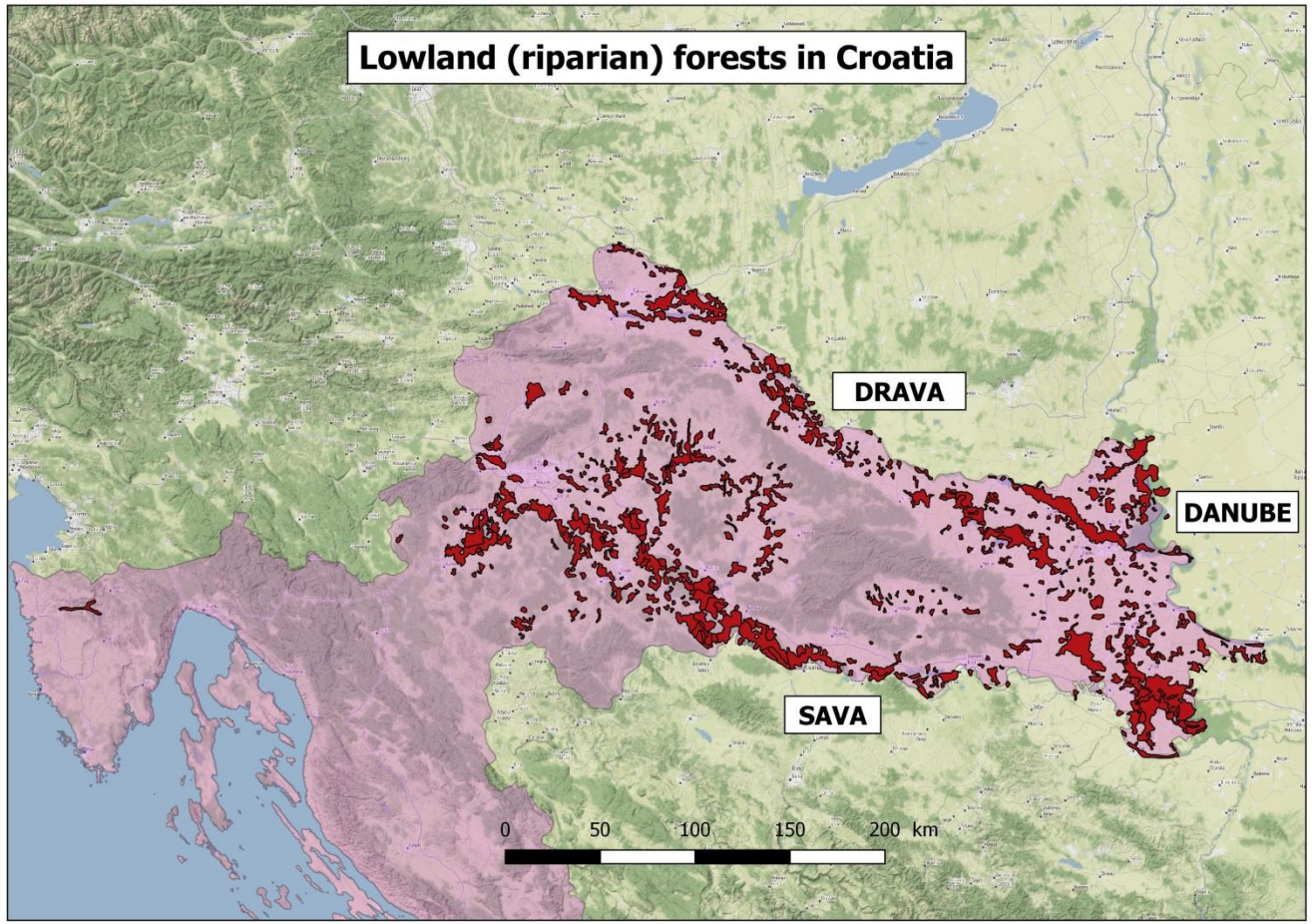
The professional workshop and forestry training of the „Protection of the English oak in the cross-border area (Oak protection)"
Headquarters of the Regional Committee in Pécs of the Hungarian Academy of Sciences

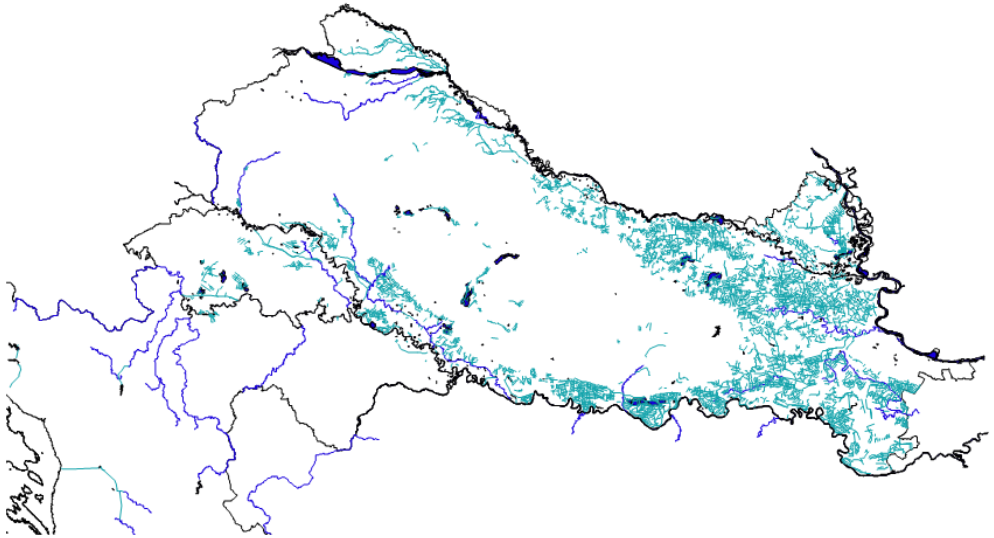
An overview of the hydrological framework of the Oak Protection project

Ivan Pilaš

Croatian Forest Research Institute

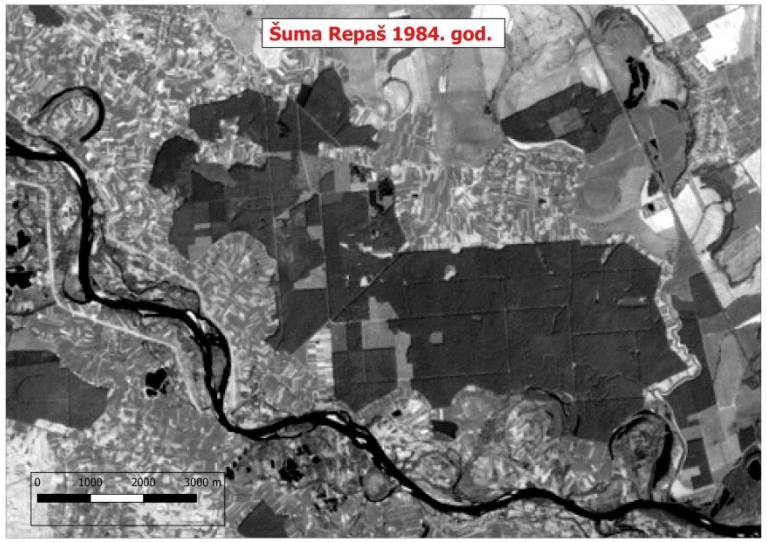
INTRODUCTION
Quercus robur forests in Croatia (200 000 ha)

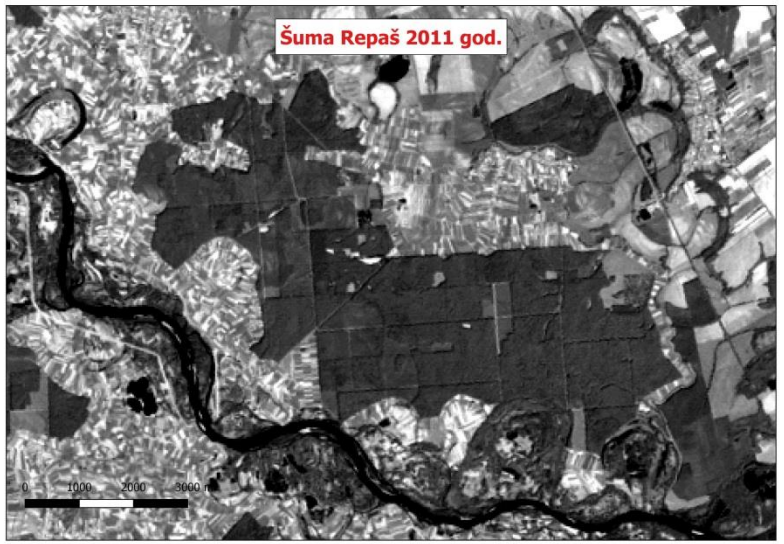




SAVA river basin - Flood defense system „Middle Posavina” – Use of the riparian lowland forests as flood retention areas

Drava river basin – Constructed reservoirs and HP plants



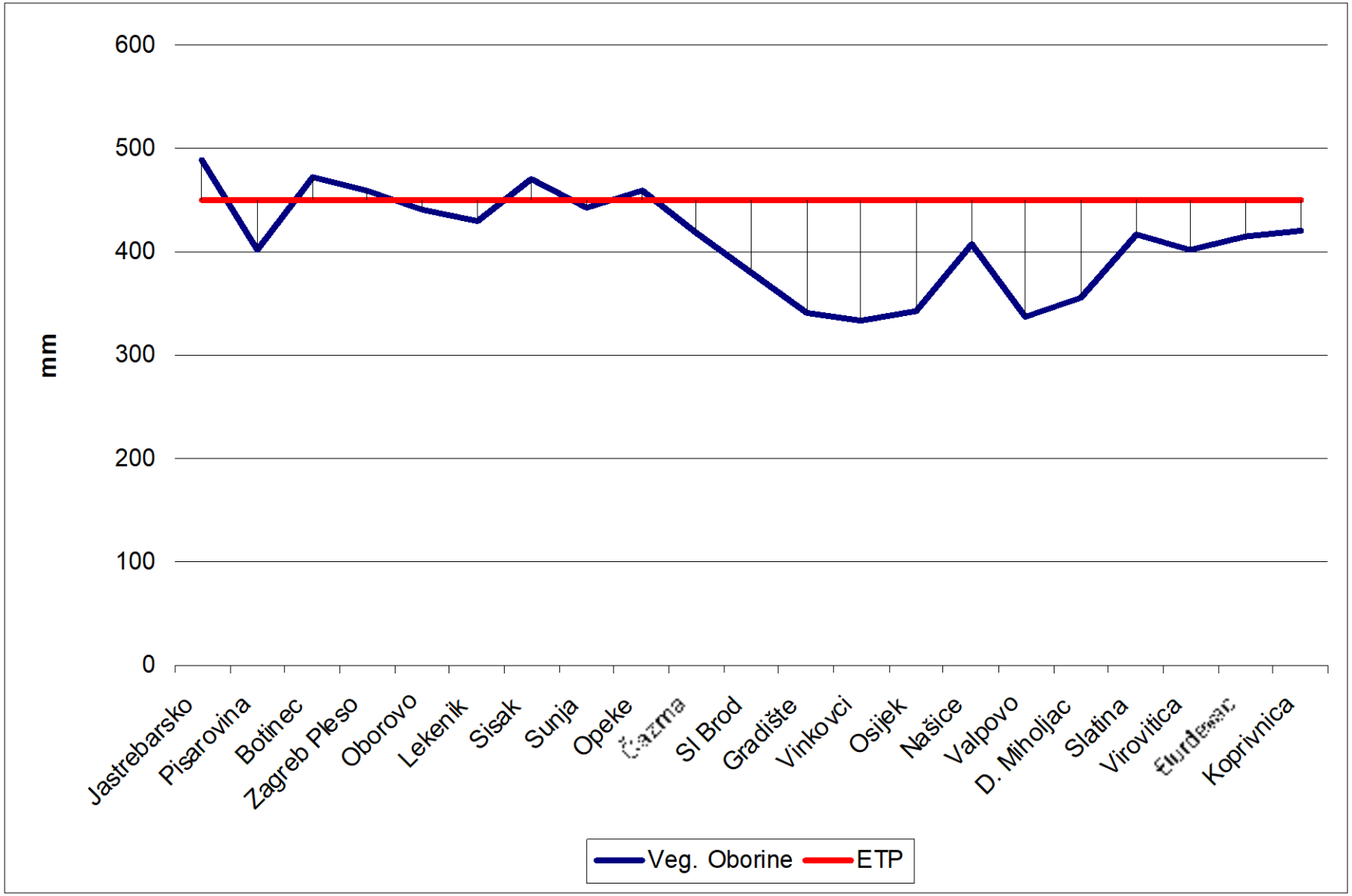


WATER DEMANDS OF COMMON OAK (Quercus robur L.)

- Forest of common oak and birch (Lysimeter St. Arnold, SCHROEDER 1987)
  - Average yearly precipitation (748,2 mm)
  - Evapotranspiration (449,0 mm)
  - Stand transpiration (363.6 mm)

- Old common oak forest (heat balance - sap flow) during vegetation period (PENKA et. all. 1983)
  - Transpiration of single tree (12 – 24 $m^{3)}$
  - Stand transpiration (250 – 450 mm)

•Relationship between oak forest evapotranspiration and spatial decrease of average amount of precipitation in vegetation period from western to eastern part of Croatia



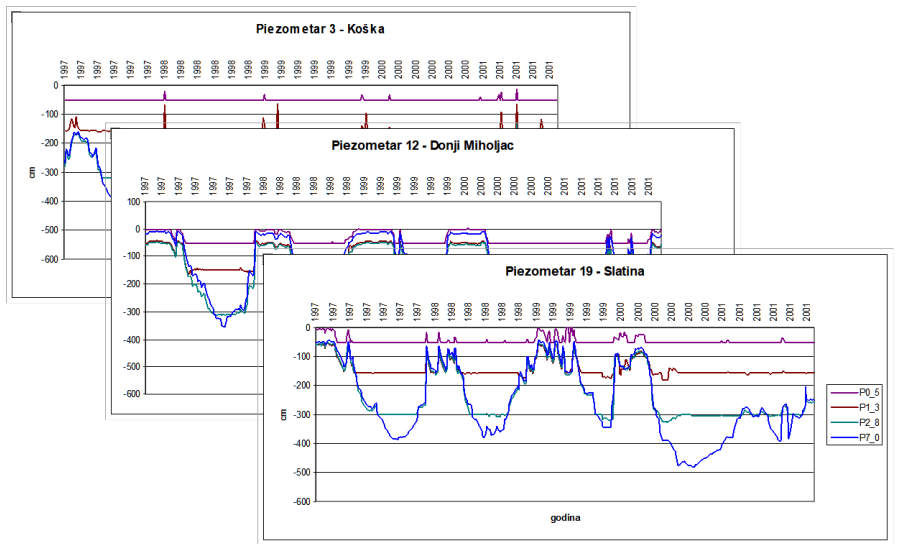
IZVORNI ZNANSTVENI ČLANCI – ORIGINAL SCIENTIFIC PAPERS
UDK 630* 181.3 + 581

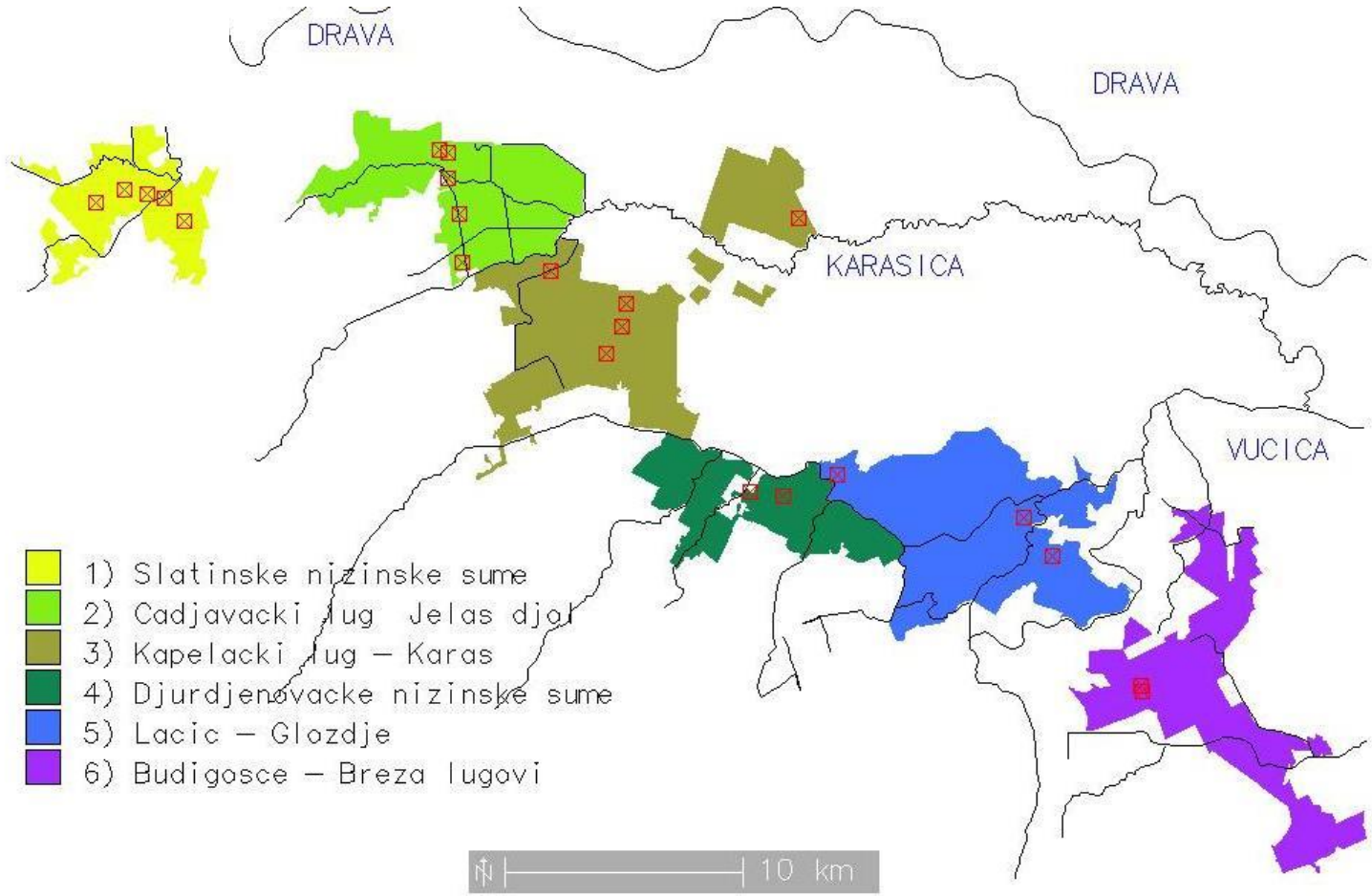
Šumarski list br. 7–8, CXXVIII (2004), 363-374

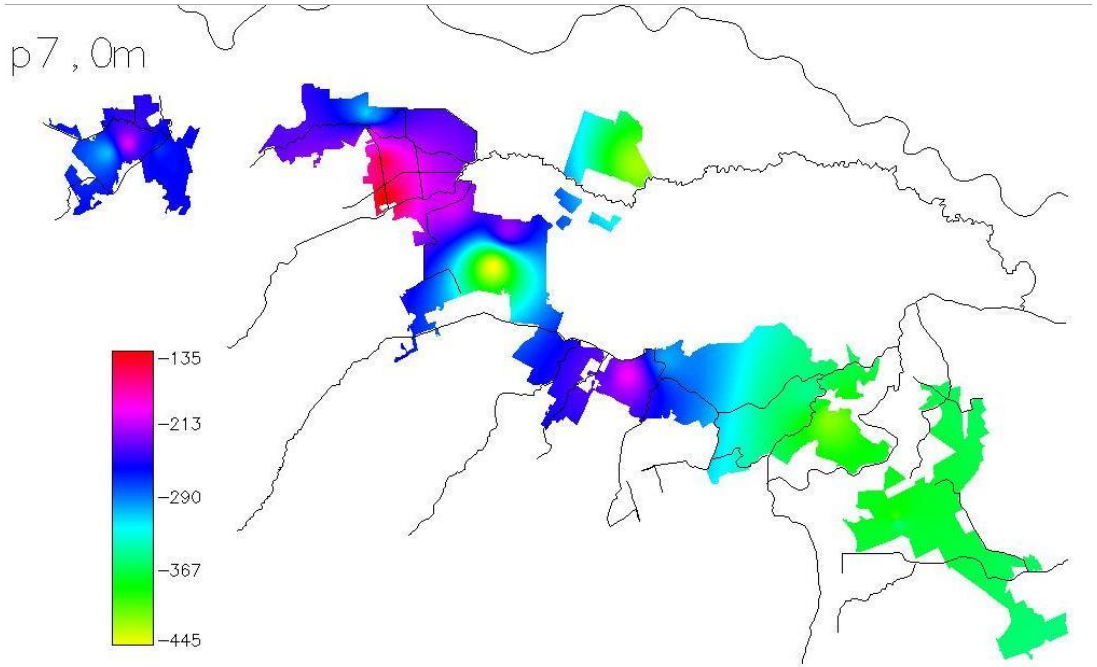
ANALIZA REŽIMA PODZEMNIH VODA NAŠIČKIH NIZINSKIH ŠUMA PRIMJENOM GRASS GIS ALATA

AN ANALYSIS OF GROUNDWATER REGIME OF LOWLAND NAŠICE FOREST AREA BY USE OF GRASS GIS

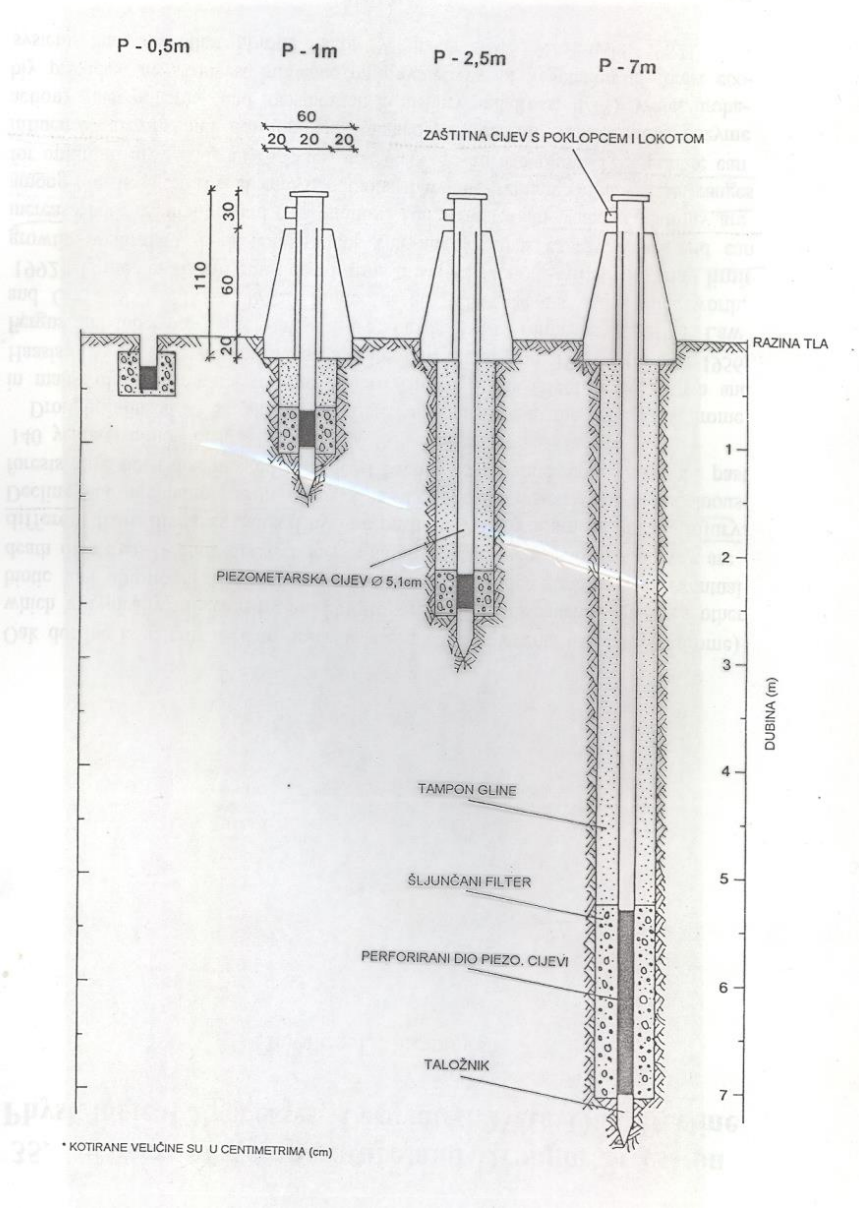
Ivan PILAŠ[1], Ante SELETKOVIĆ[1]



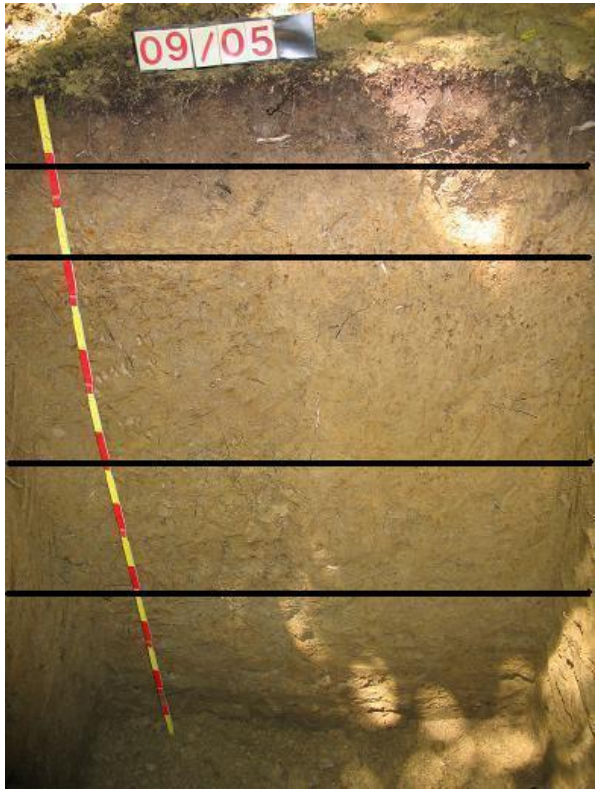




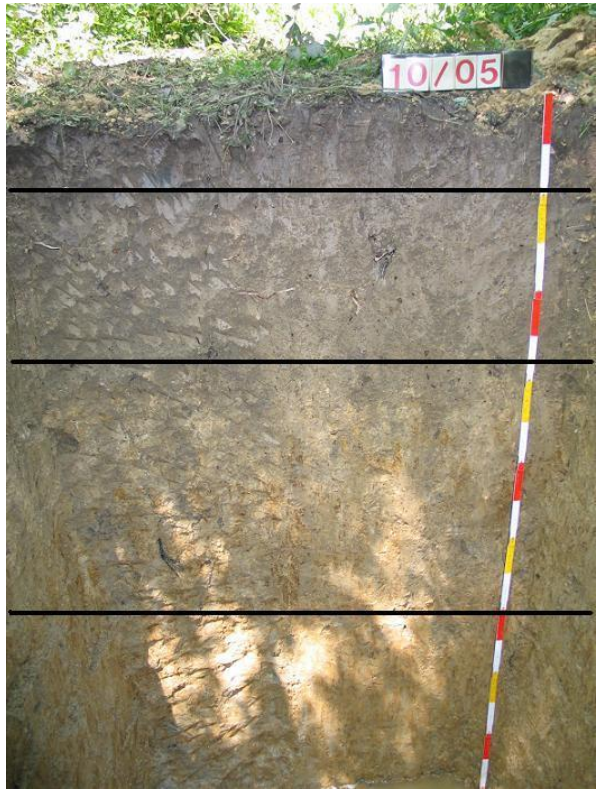
SKICA BATERIJE PIEZOMETARA NA JEDNOJ VODOMJERNOJ LOKACIJI (STACIONARU) U NIZINSKIM ŠUMAMA U.Š. NAŠICE (1994)



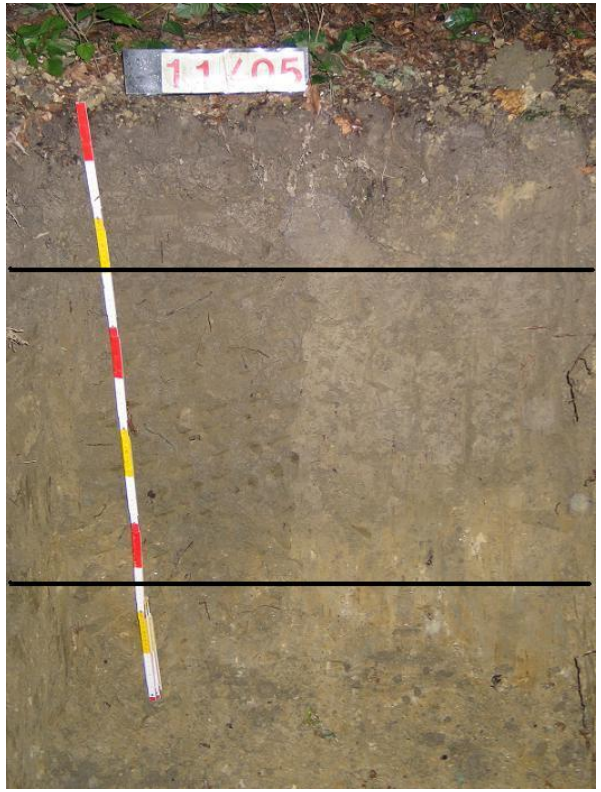
Pseudoglej-glej

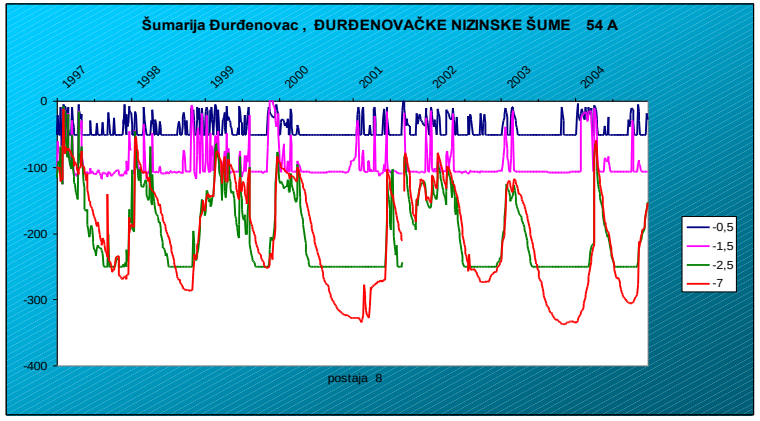


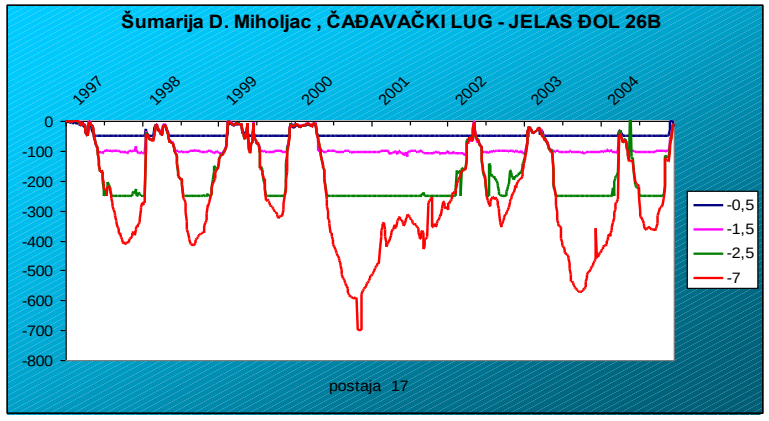
Euglej, amfiglej

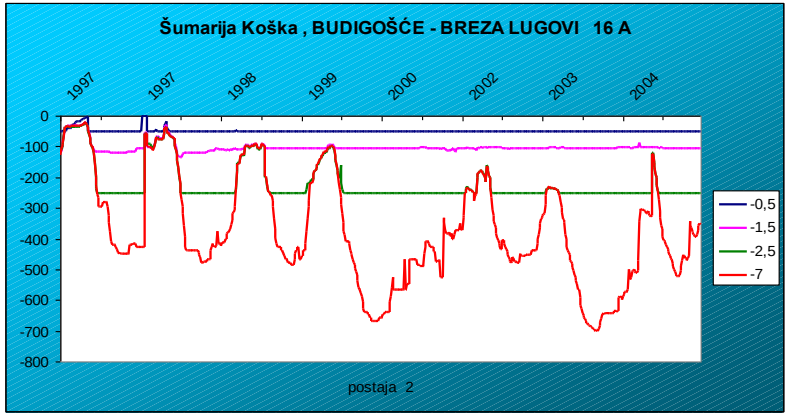


Euglej, hipoglej

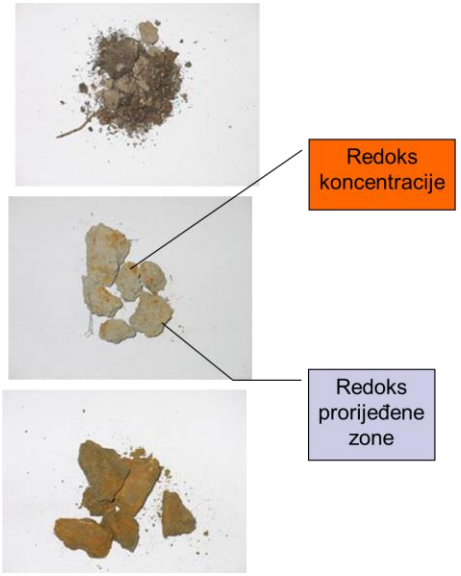






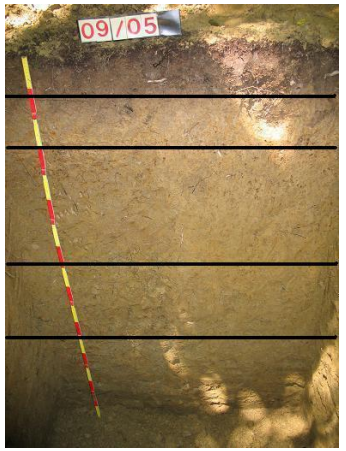


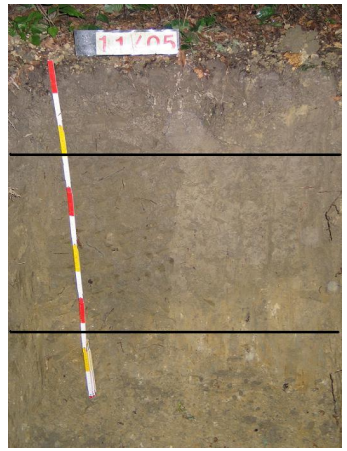
Root distribution of quercus robur in soils (Pilaš 2006)

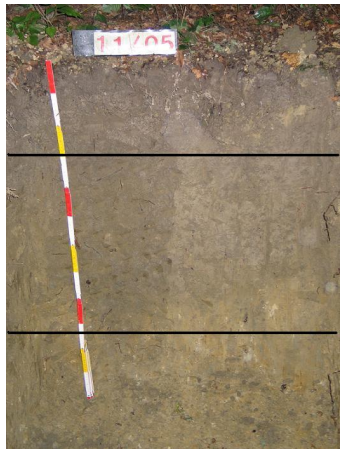


Oxydized rhizosphere

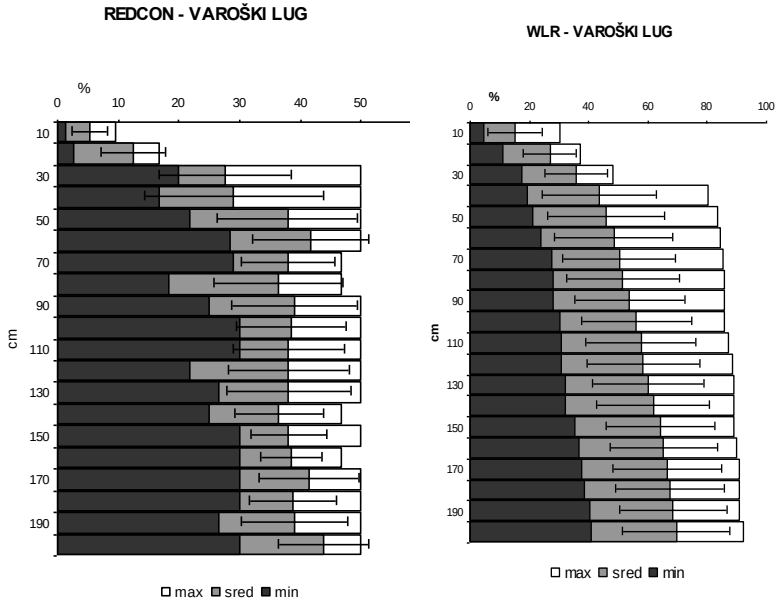
Roots distribution vs Waterlogging



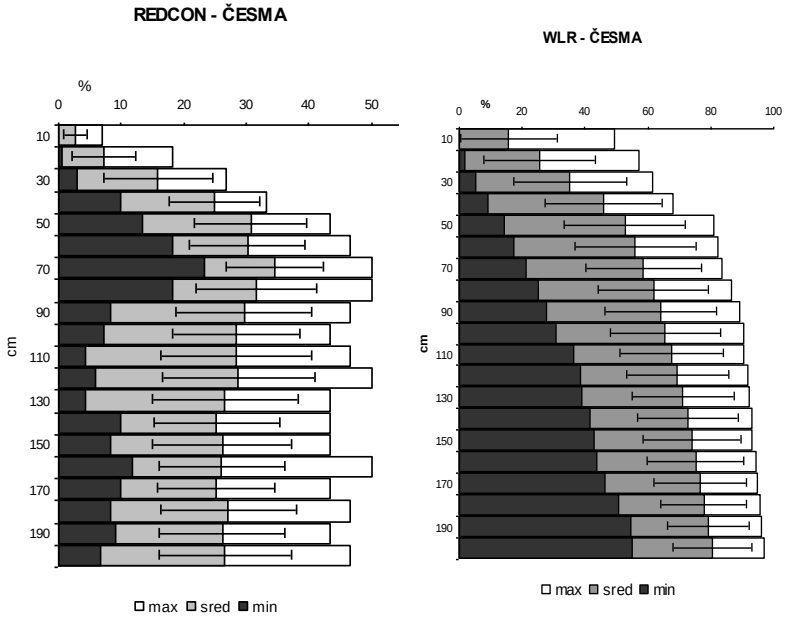




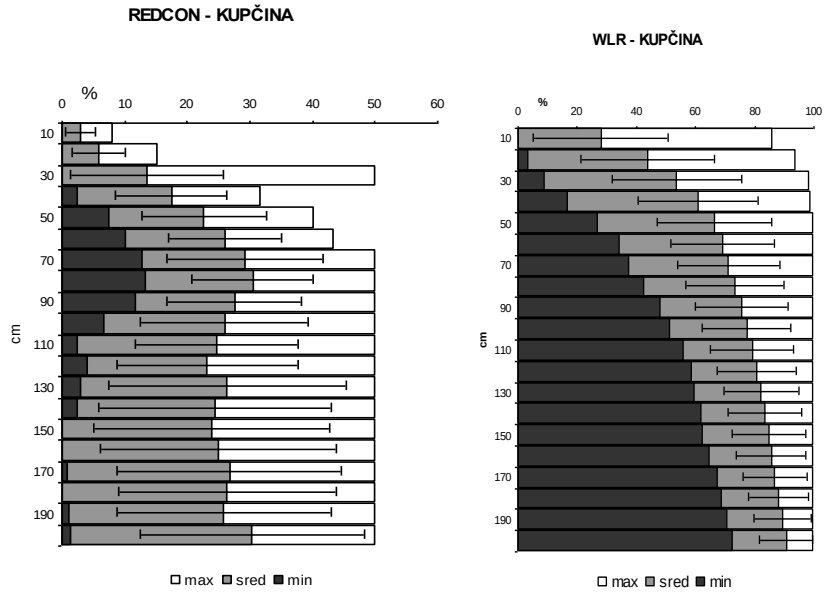
Drier soil - pseudogley



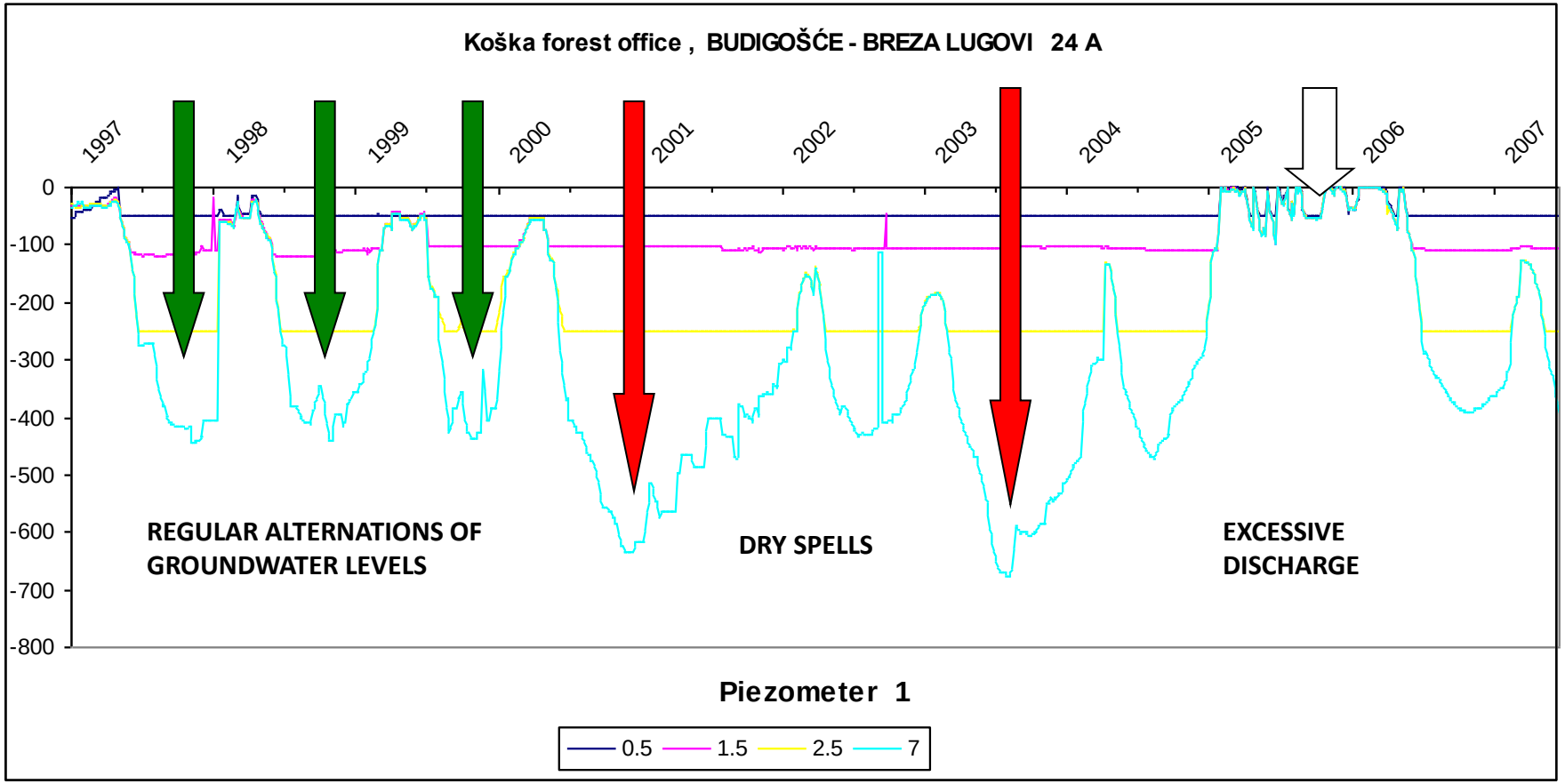
Medium wet soil – pseudogley-gley



Wery wet soil – amphygley, hypogley



Project motivation – Observed Rapid decline of Groundwater tables after 2000!



1998 (1997)

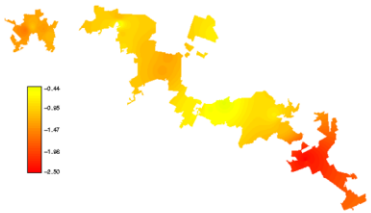
1999 (1997)

2000 (1997)

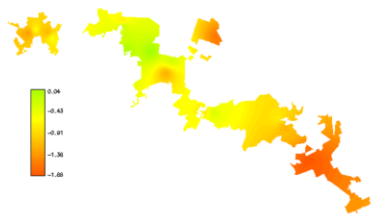
2001 (1997)

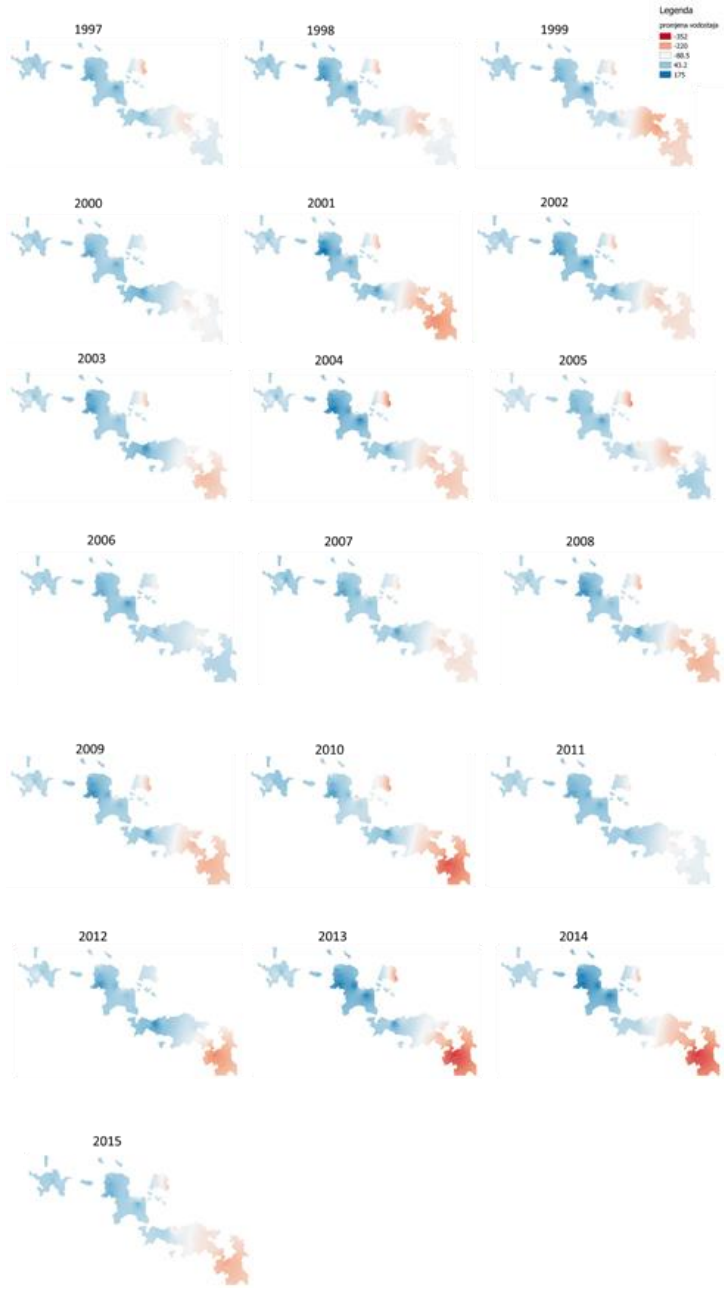
2002 (1997)

2003 (1997)

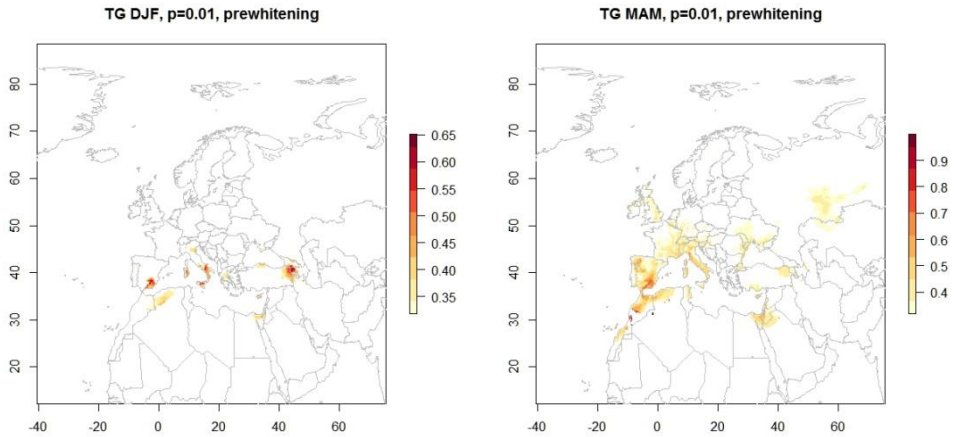


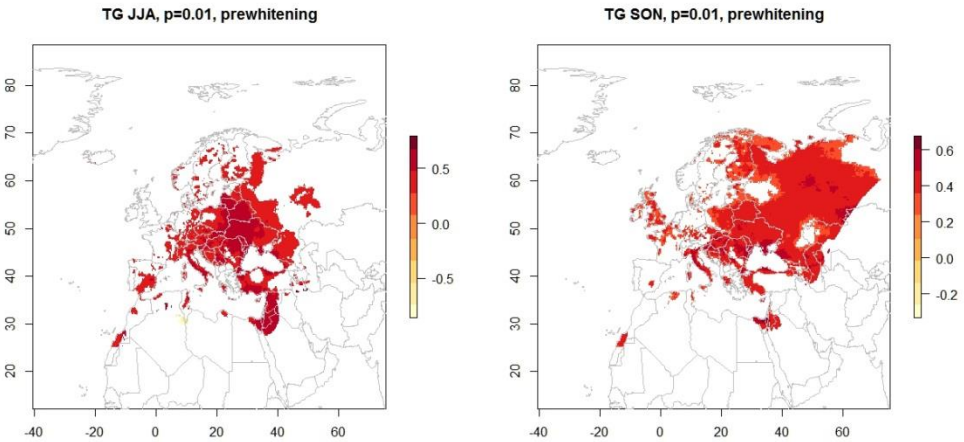
2004 (1997)

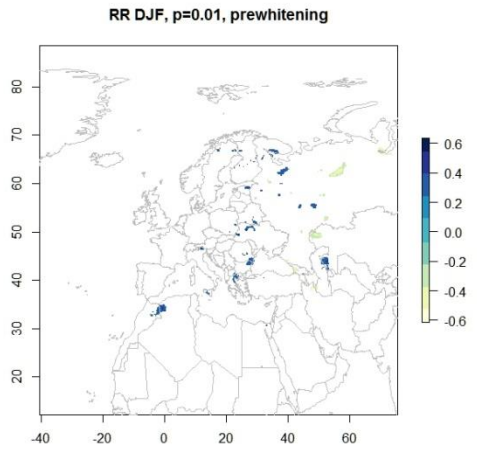


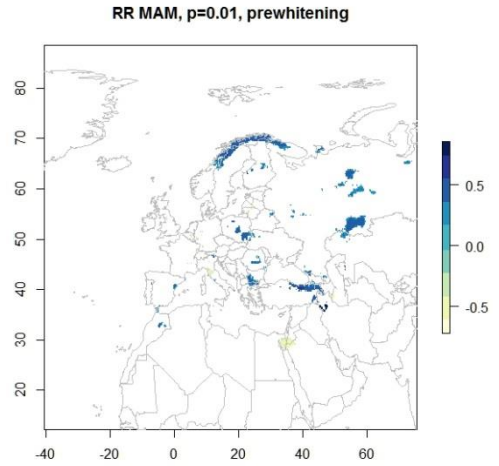


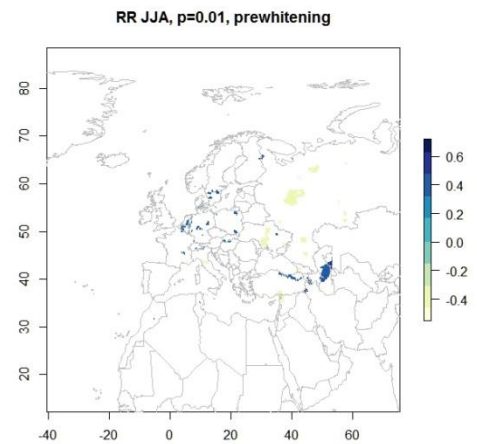
Observed temperature and precipitation trends in Europe 1982-2015 (Pilas 2018)

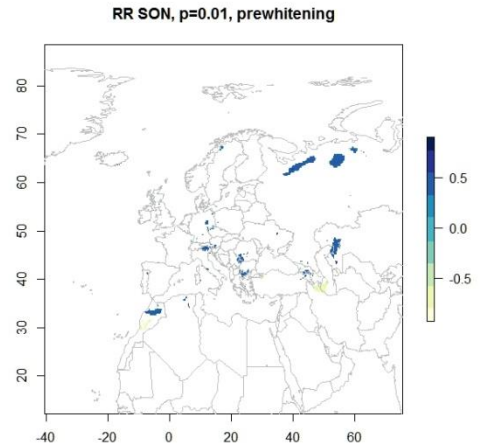






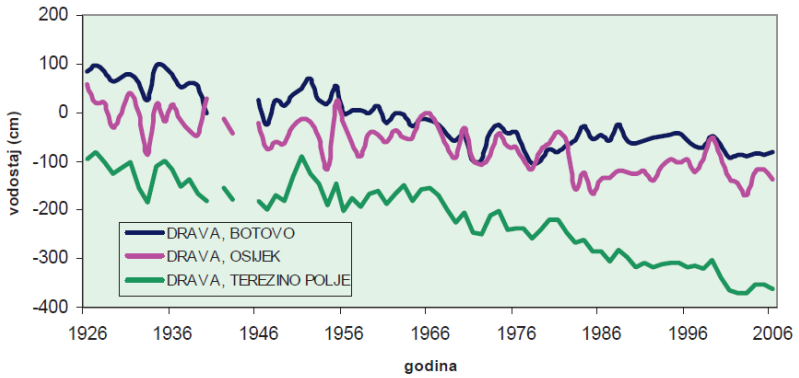






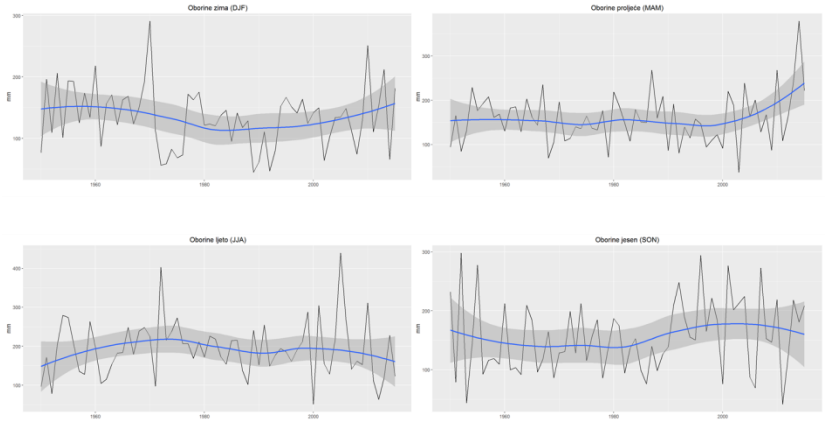
Hydro-climatic changes in the region (*summer-autumn desiccation, increased runoff and more extreme precipitation, lowering of winter groundwater recharge due to snow reduction and Drava riverbed erosion!*)

Trends of minimal Drava waterlevels

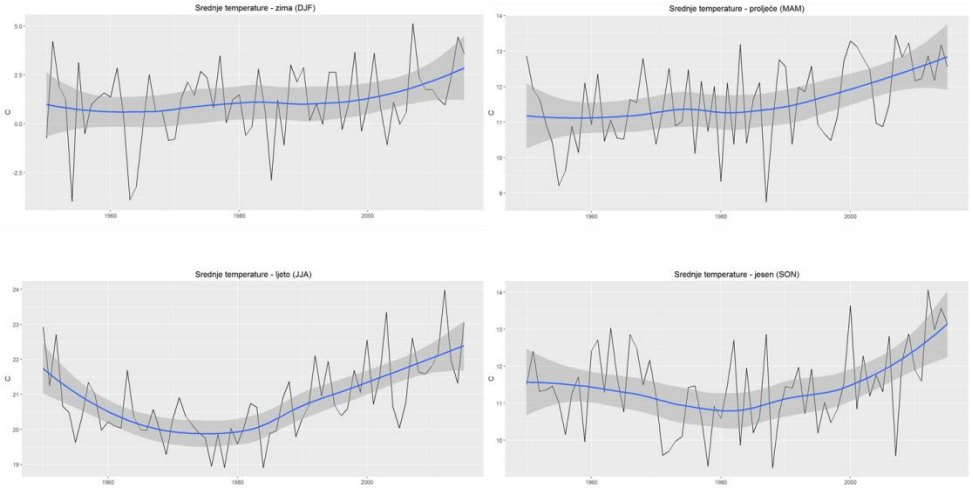


Slika 2.5. Vremenski nizovi najnižih godišnjih vodostaja zabilježenih na karakterističnim stanicama na Dravi

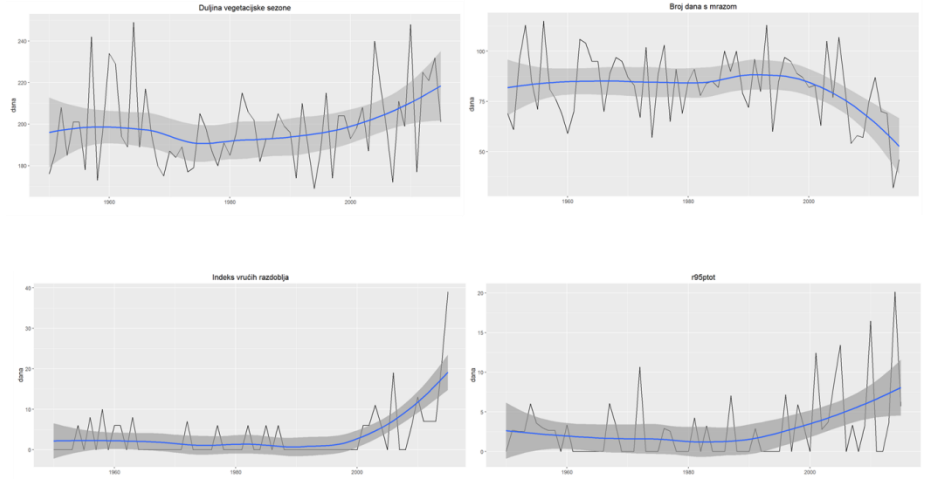
Seasonal precipitation trends

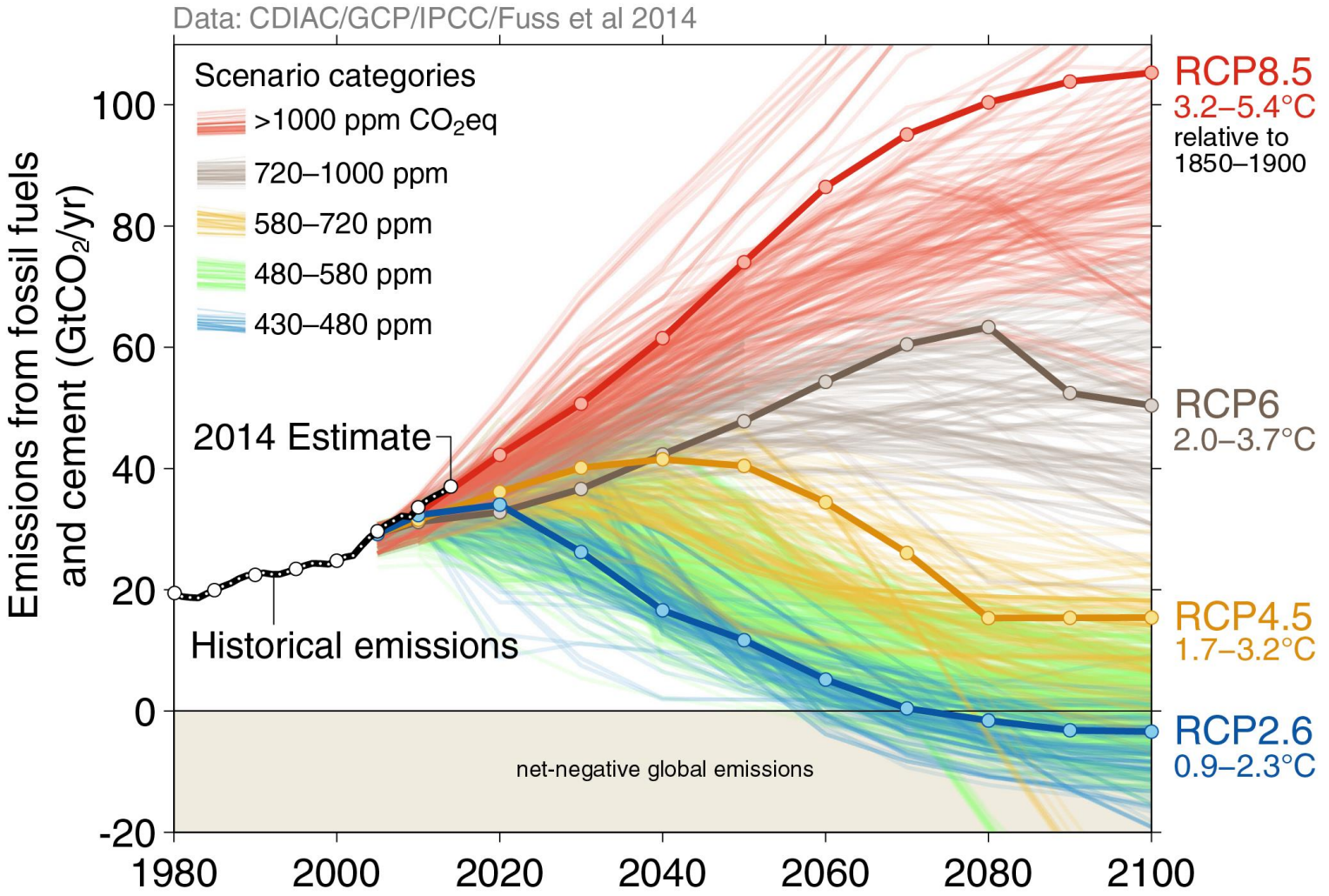


Seasonal temperature trends



Indices of climatic extreemes



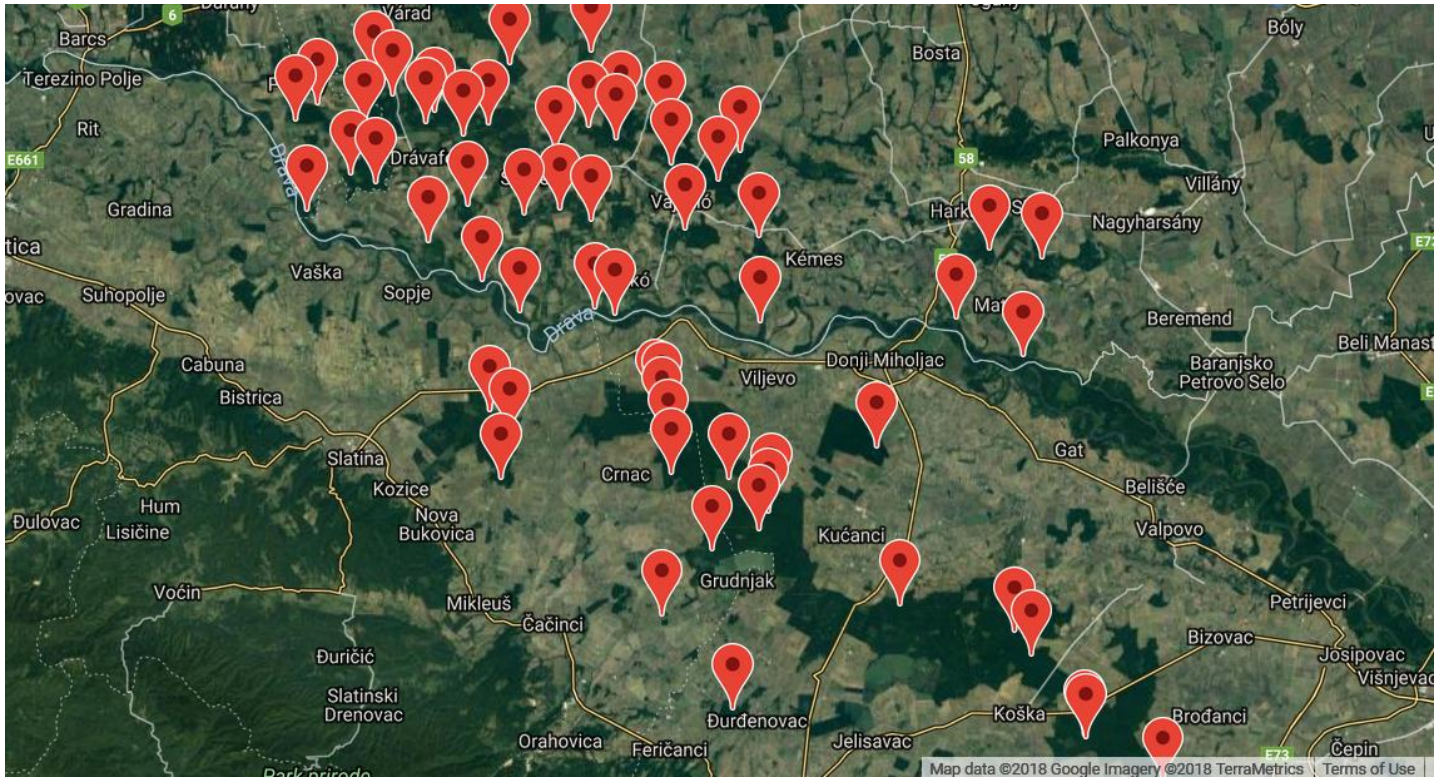


Oak rotation period 140 years!!!

The hydrological objectives of the Oak protection project:

I) transboundary automatic groundwater monitoring system for ground and surface water (piezometers, loggers)

- Semi- automatized monitoring of the present and future hydrologic changes and assessment of ecosystems suitability for Quercus robur on 52 piezometric stations (30 Hungary, 22 Croatia)



-Installation of new piezometers (6 Croatia, 30 Hungary) (Geolab d.o.o Varaždin) DONE!

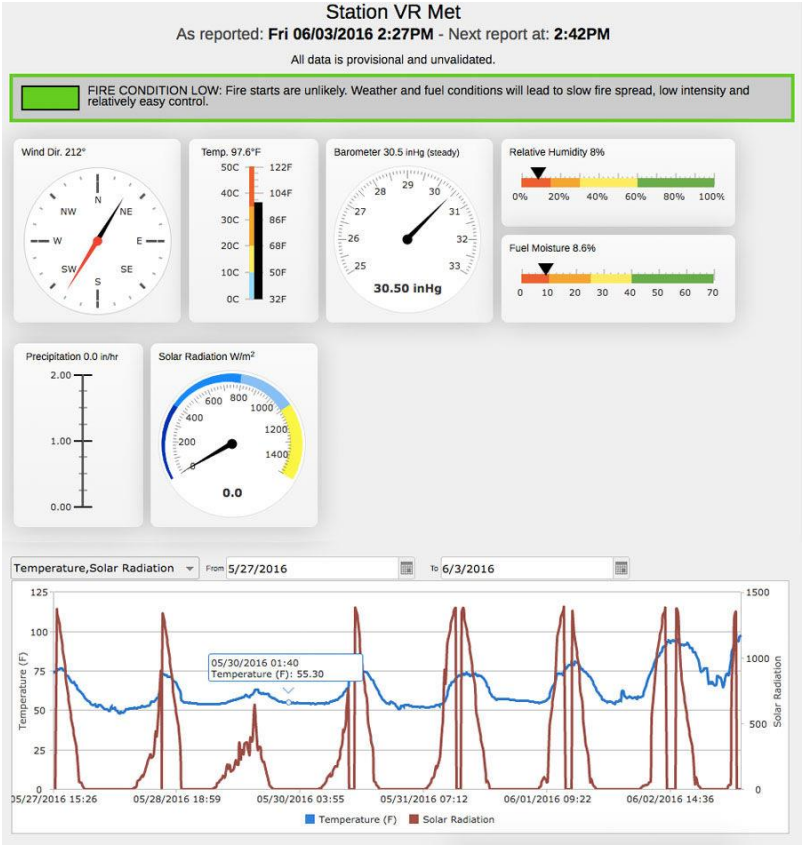
- Procurement and installation of 44 automatic groundwater loggers-divers (Megra d.o.o., Belgrade) – Procurement complited, installation of divers, beginning of July

Eijkelkamp
Soil & Water

II) transboundary automatic weather monitoring (early warning) system

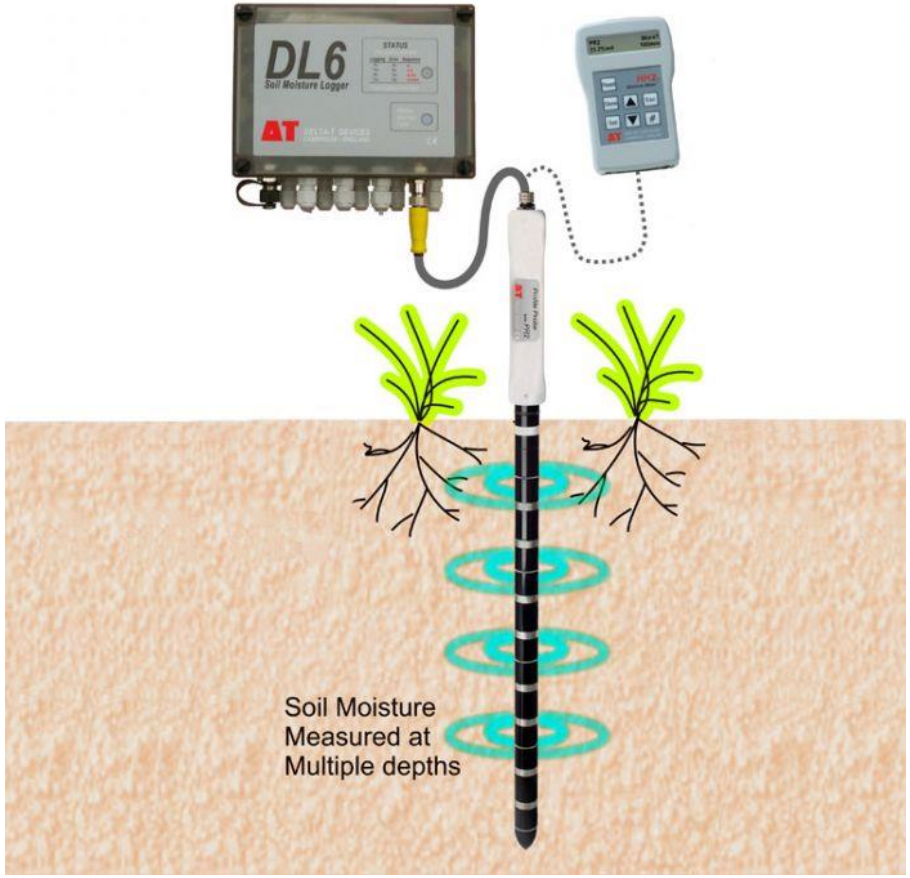
- Fully automatized real-time monitoring of the weather condition in forest areas on 7 weather stations (5 in Croatia, 2 in Hungary) Procurement complited
- Drought and extreeme floods detection, weather condition suitability for pest and deaseses infestation

CAMPBELL SCIENTIFIC®
WHEN MEASUREMENTS MATTER



III) Ground and surface water quality monitoring, soil moisture monitoring, portable soil laboratory (Megra d.o.o., Belgrade, procurement completed)

Soil moisture probe and aditional tubes for soil moisture monitoring to 1 m depth on multiple locations (piezometers, nurseries, oak seed plantations…)



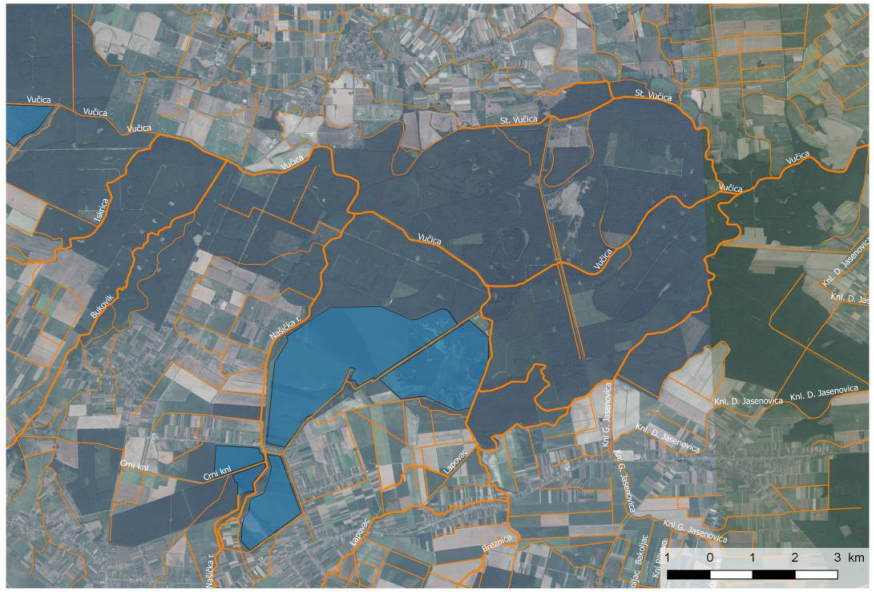
Portable soil test kit

IV) Assessment of the state and future projection of the ecosystems with proposal of adaptive forest-water retention measures (based on precise Lidar topography) to enhance ecosystem stability – Koška study

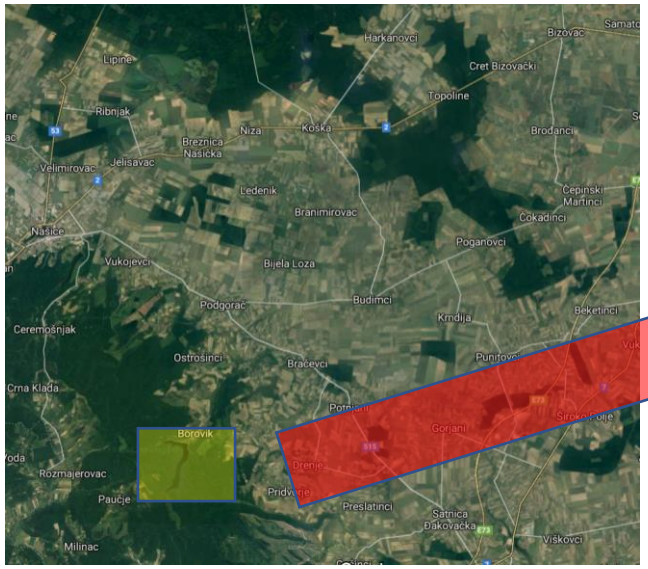
Lidar topografy 6000 ha:

Izvršitelji	vodeći član zajednice ponuditelja: PERCEPTIVES ecosystem services in a perceptive way Koprivnička 38; HR-10000 Zagreb www.perceptives.org ++ 385 99 67 868 20 info@perceptives.org OIB: 17113702394 član zajednice ponuditelja: BIOTA Braće Radića 128A, HR-43290 Grubišno Polje ++ 385 98 67 868 20 OIB: 00559208747
Voditelj projekta	Dr.sc. Stjepan Dekanić, dipl.ing.šum.
Stručnjaci	Doc.dr.sc. Stjepan Mikac, dipl.ing.šum. Dr.sc. Boris Vrbek, dipl.ing.šum. Dr.sc. Dušan Jelić, prof.biol.

Intensive flooding of forests by river Vučica, Papuk watershed, stagnant surface water due to the constructed road network, decline of groundwater (G.J. Lacić Gložđe)

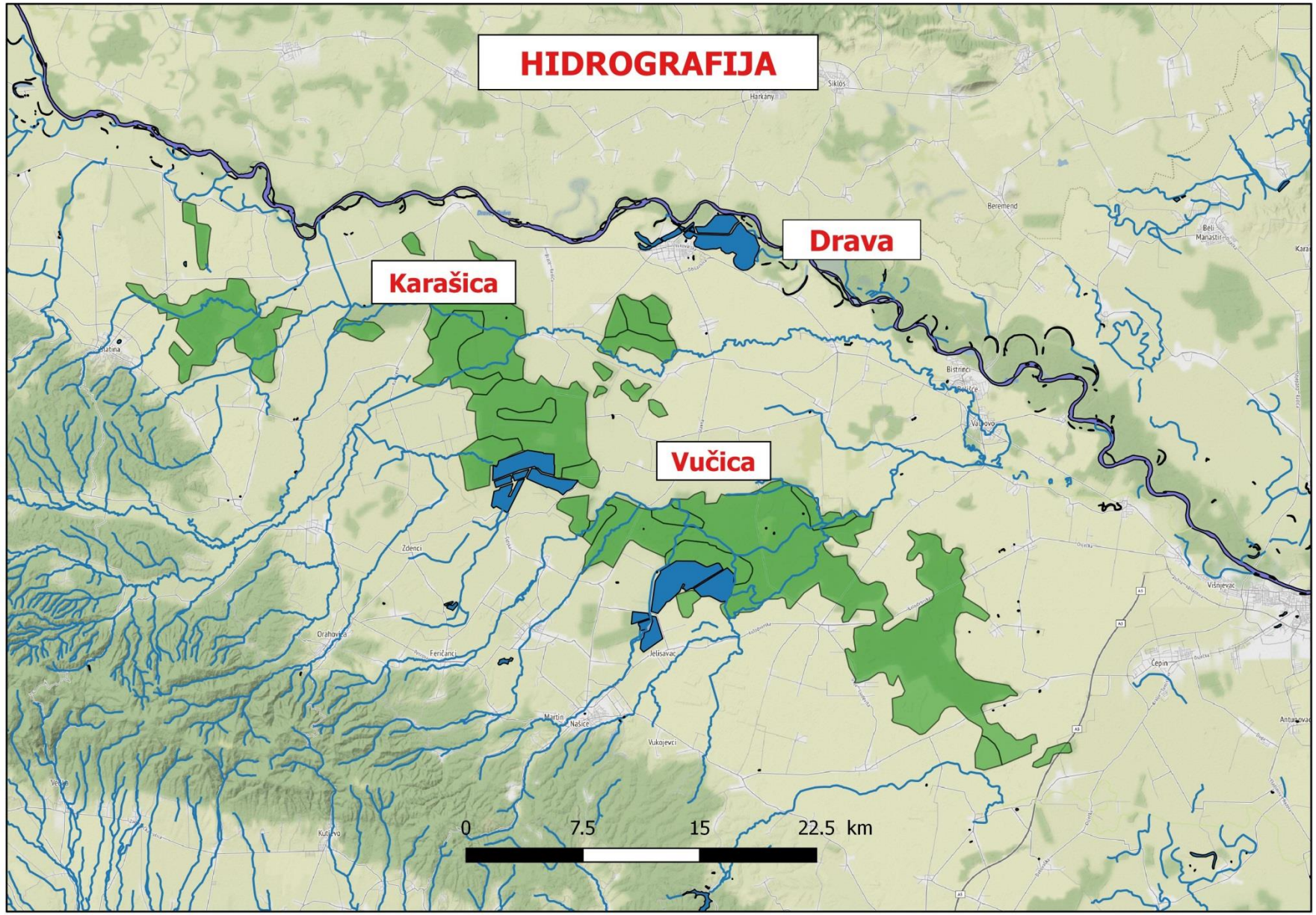


Reduction of natural flooding of forests by drainage canal Zečevac from Borovik water reservoir, dried out natural ponds, intensive decline of groundwater (G.J. Lacić Gložđe)



Goals of the Koška study

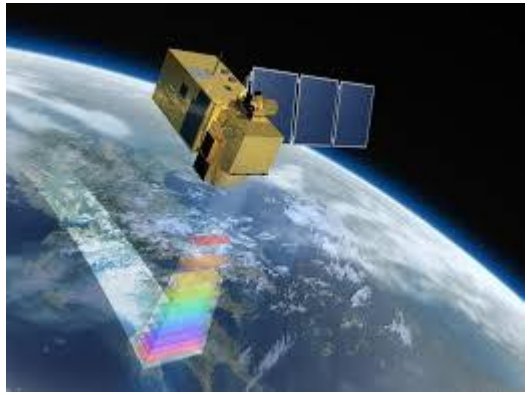
- **I) An assessment of the forest ecosystems state**
  - Stand parameters
  - Dendrochronological analysis
  - Soil characterization and analysis
  - Analysis of the state of the surface water bodies (ichtiofauna)
- **II) Projections of the future ecosystems development**
  - Projections of the future groundwater advancement (statistical modelling, groundwater model DRAINMOD)
  - Projection of the future oak stand growth
- **III) Recomendations for the forest and water managers**
  - System for rapid detection and management of forest threats (droughts, pests & deseases , forest damages
  - Flood and drought management – estabilishement of sustainable flooding regime (reducing of flood duration and prolonged accumulation of surface water) and water retention measures (retaining water during drought)


HIDROGRAFIJA
Drava
Karašica
Vučica
0
7.5
15
22.5 km

V) Oak protection WEB – GIS

- Trans boundary hydro-climatic (near real time) & invasive species monitoring and decision support system based on WEB – GIS interface

- System for Integration and Web presentation of the monitoring data and the results of the project:
  - Real time presentation of **climatic information** from weather stations (*Climate alarm!)*
  - Quartarly interpolated maps of the **groundwater tables** from the piezometric network
  - **Forest condition monitoring** and change detection based on Copernicus Land Monitoring System (*Sentinel 2 10m resolution satellite observations*)
  - Static maps of **invasive species** distribution with posibility of inputs of the newly detected field point observations with photographs (*Invasive species alarm*!)
  - **Web dictionary and tutorial** for determination of the new invasive species
  - **Other:** map with location and description of especially interesting and valuable natural sites for recreational purposes…

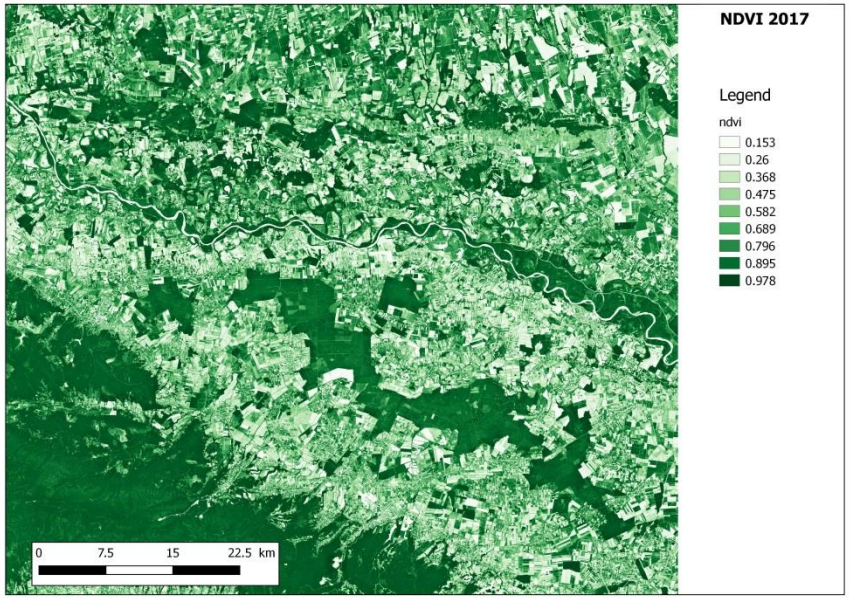


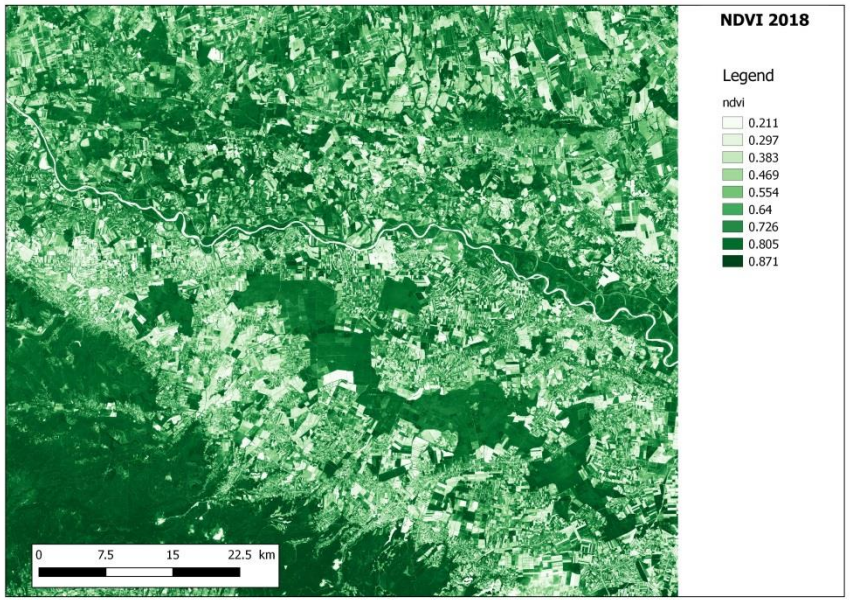
Sentinel 2 – June 2017

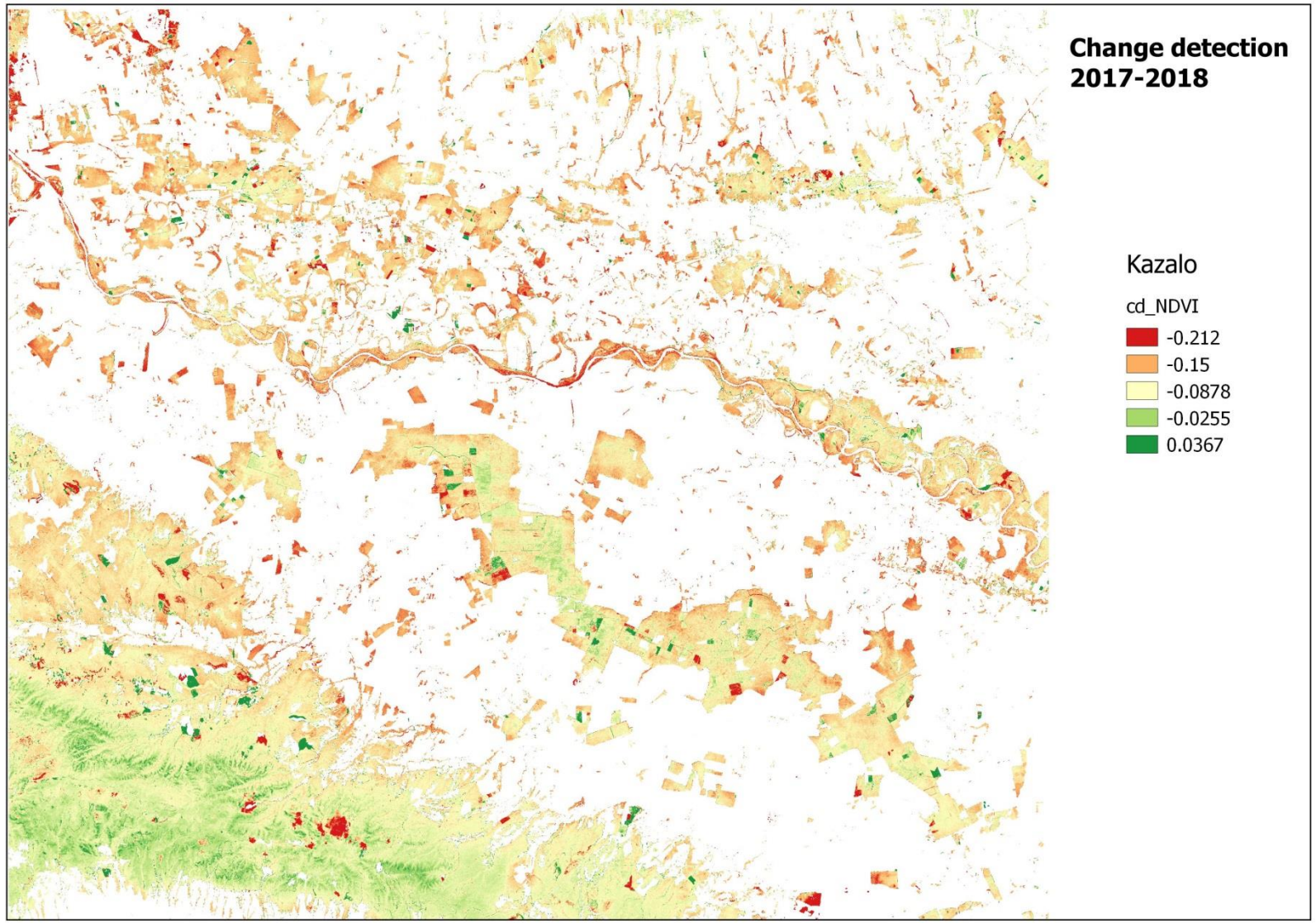
Sentinel 2 – June 2018

NDVI – Normalized Difference Vegetation index

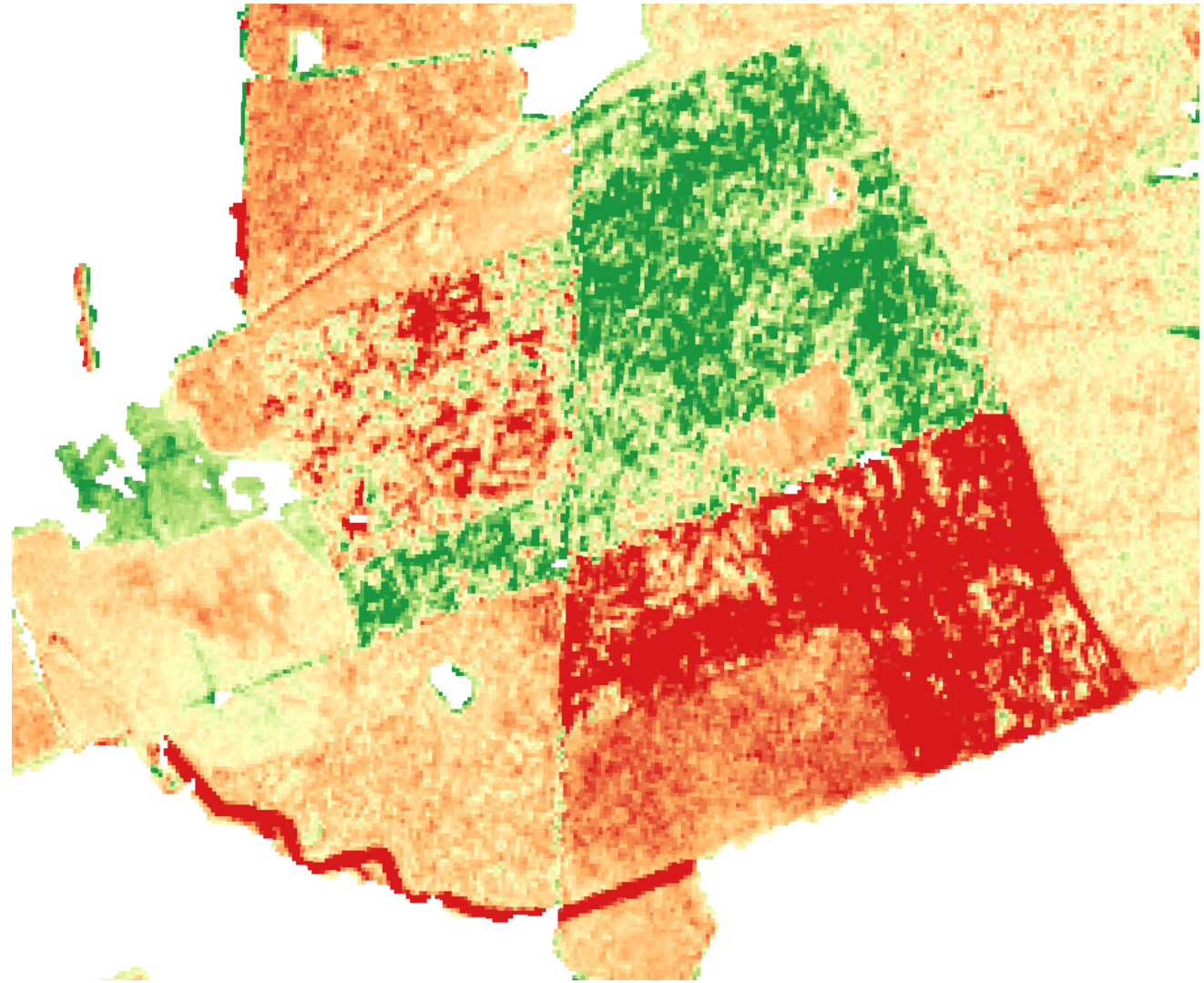
- Sensitive to changes in the forest biomass (stand cutting, thinning, replanting)
- Suitable for the detection of various silvicultural works in forests


NDVI 2017
Legend
ndvi
0.153
0.26
0.368
0.475
0.582
0.689
0.796
0.895
0.978
0
7.5
15
22.5 km

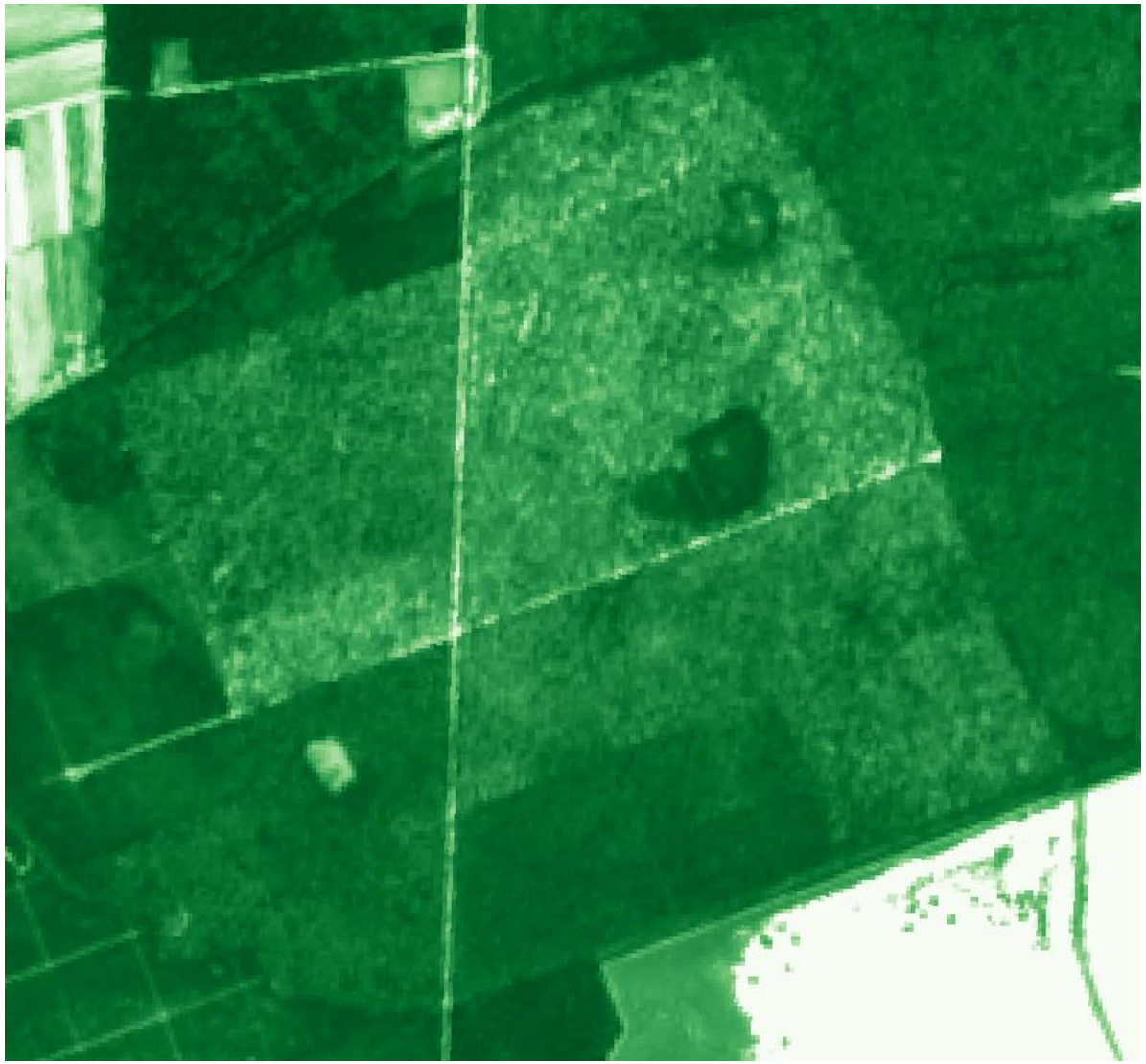

NDVI 2018
Legend
ndvi
0.211
0.297
0.383
0.469
0.554
0.64
0.726
0.805
0.871
0
7.5
15
22.5 km


Change detection
2017-2018
Kazalo
cd_NDVI
-0.212
-0.15
-0.0878
-0.0255
0.0367

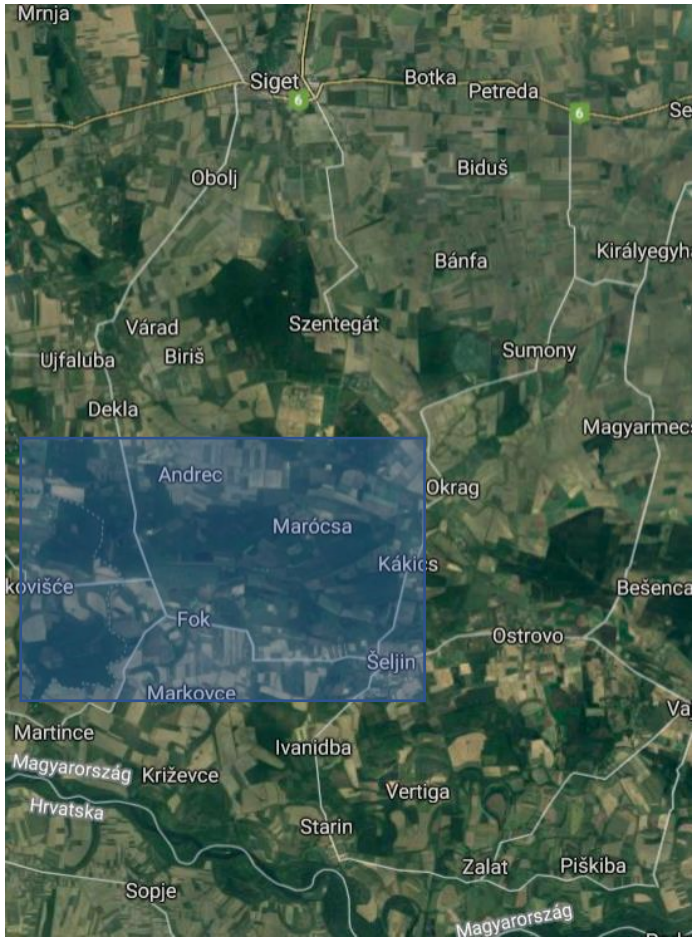

OSJEČKO-BARANJSKA ŽUPANIJA
VIROVITIČKO-PODRAVSKA ŽUPANIJA
OSJEČKO-BARANJSKA ŽUPANIJA
VIROVITIČKO-PODRAVSKA ŽUPANIJA
OSJEČKO-BARANJSKA ŽUPANIJA
VIROVITIČKO-PODRAVSKA ŽUPANIJA

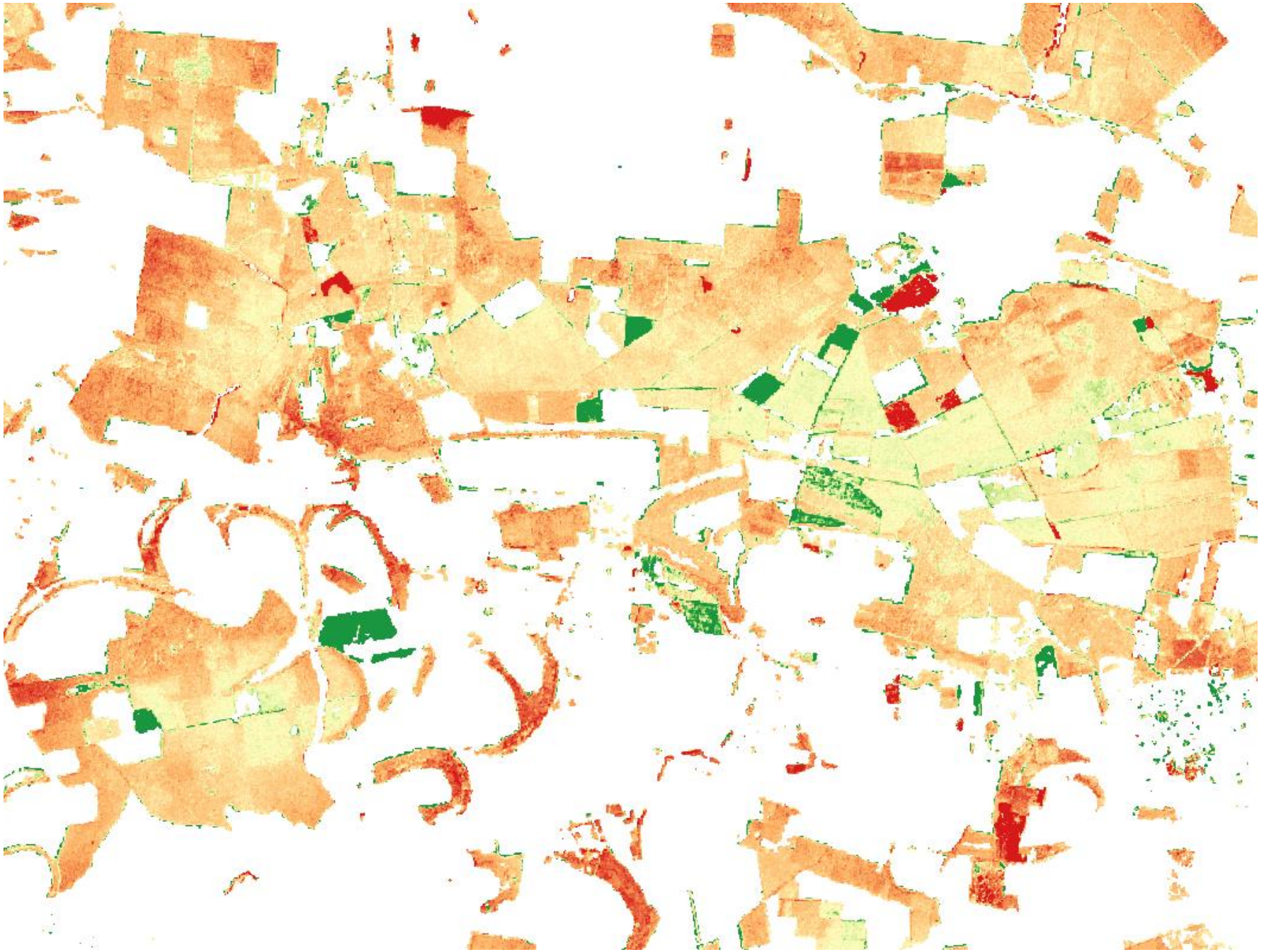


2017

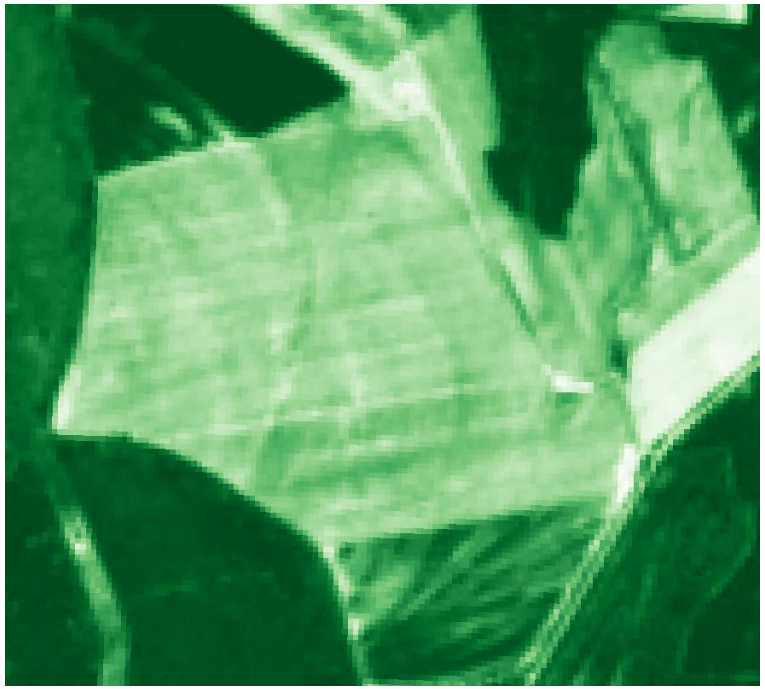


2018

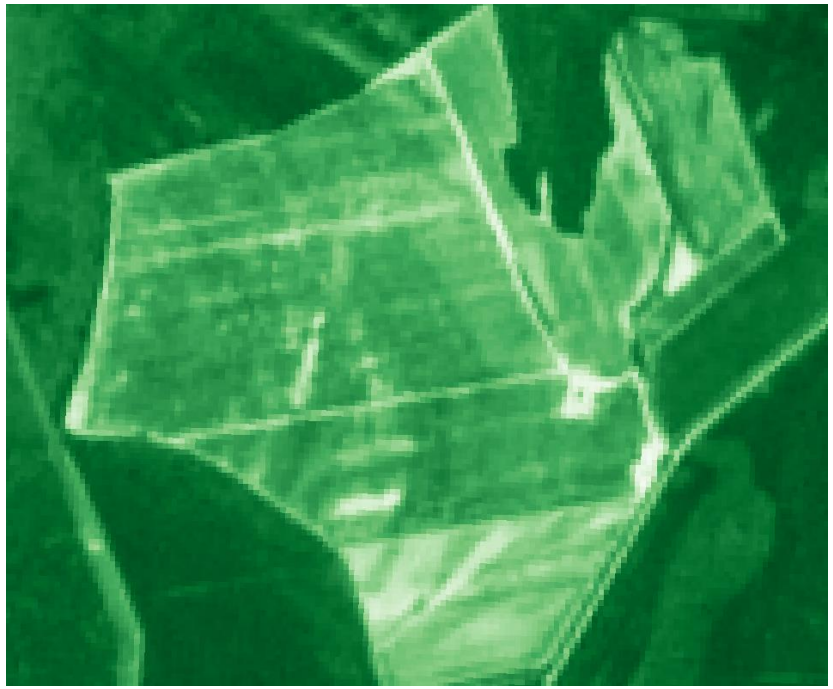

Mrnja
Siget
Botka
Petreda
Obolj
Biduš
Bánfa
Királyegyh
Várad
Szentegát
Ujfaluba
Biriš
Sumony
Dekla
Magyarmec
Andrec
Okrag
Marócsa
Kákics
Bešenca
Fok
Ostrovo
Šeljin
Markovce
Martince
Ivanidba
Magyarország
Križevce
Vertiga
Hrvatska
Starin
Zalat
Piškiba
Sopje
Magyarország

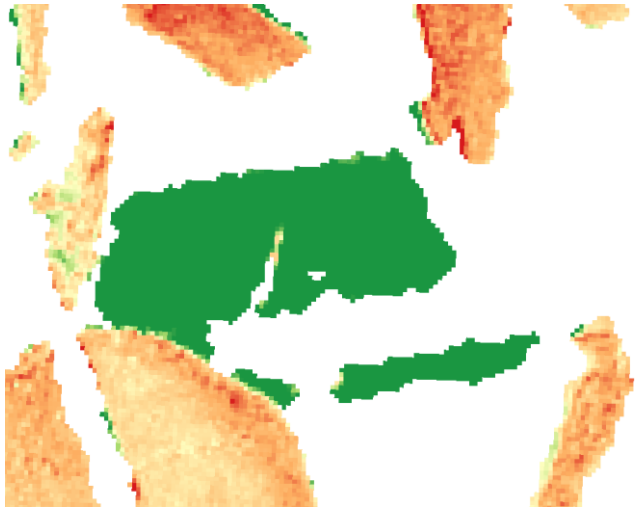


2017



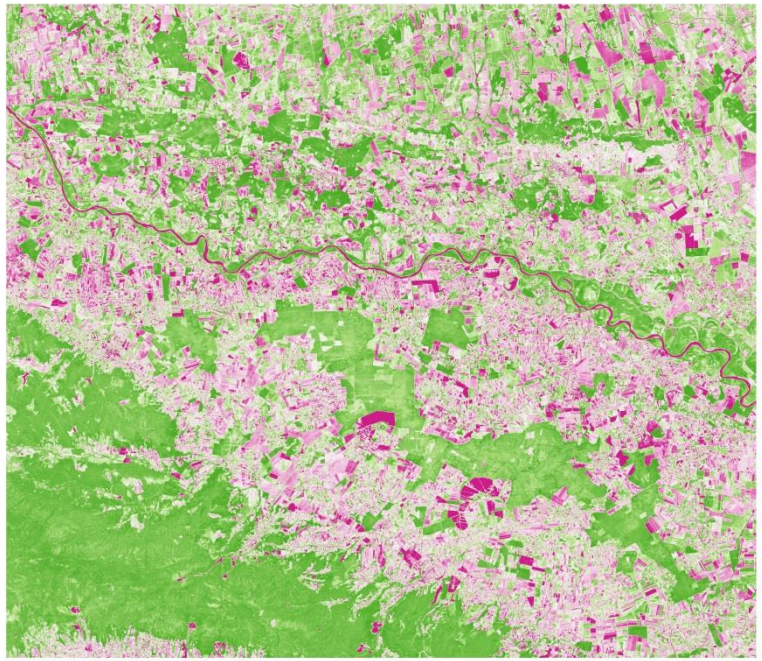
2018





GNDVI – The Green Normalized Difference Vegetation Index algorithm was developed by Gitelson et al. (1996).

- The authors verified that GNDVI was more sensible than NDVI to identify different concentration rates of chlorophyll, which is highly correlated at nitrogen. The use of green spectral band was more efficient than the red spectral band to discriminate nitrogen.

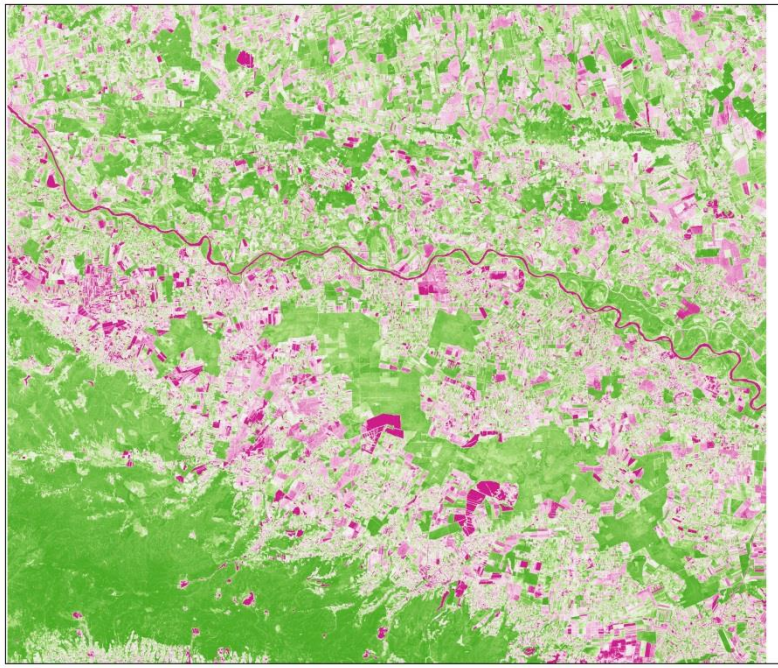


GNDVI 2017

Kazalo

gndvi

- 0.268
- 0.42
- 0.572
- 0.725
- 0.877

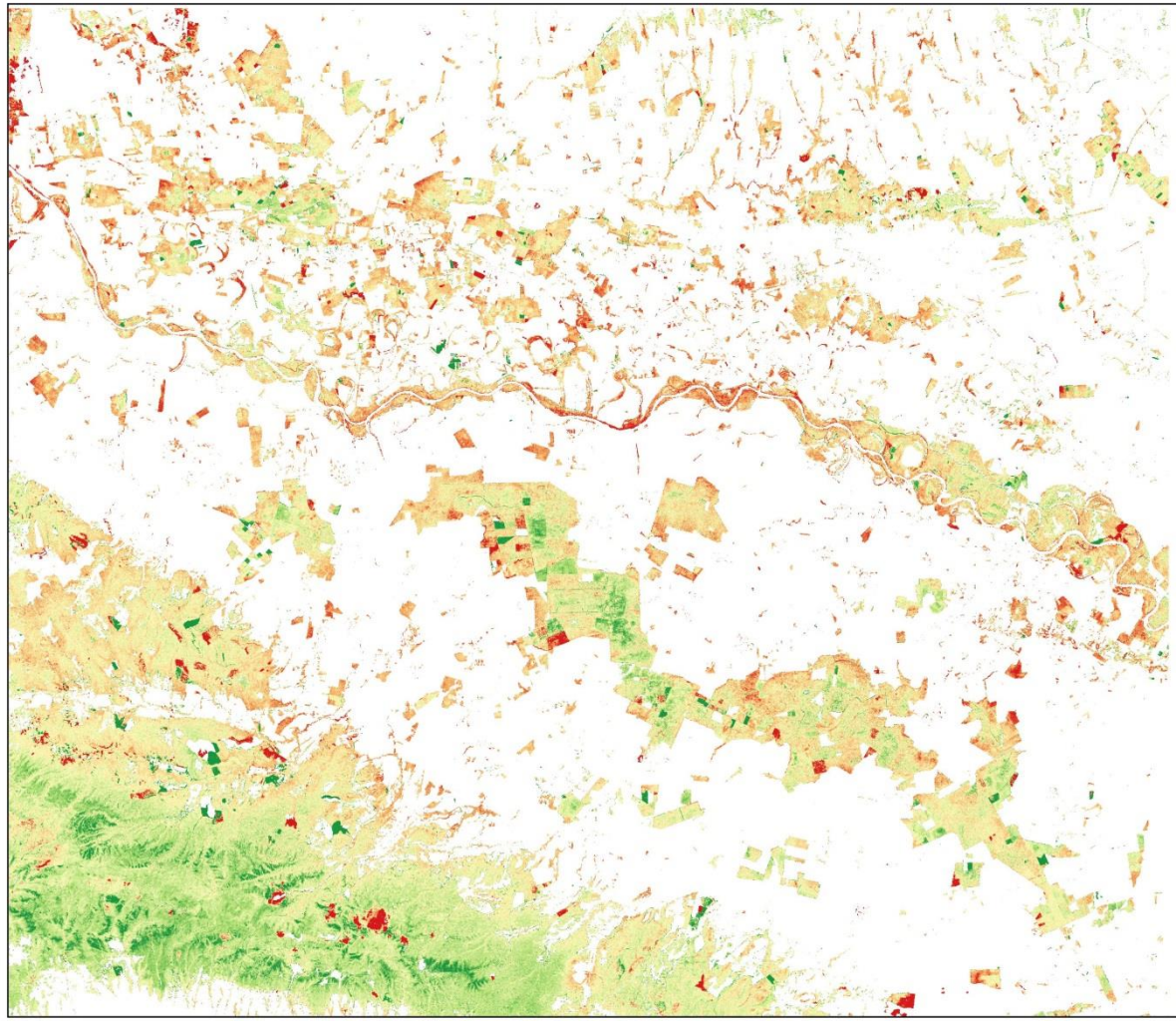


GNDVI 2018

Kazalo

gndvi

- 0.295
- 0.423
- 0.551
- 0.679
- 0.807



GNDVI change detection 2017 - 2018

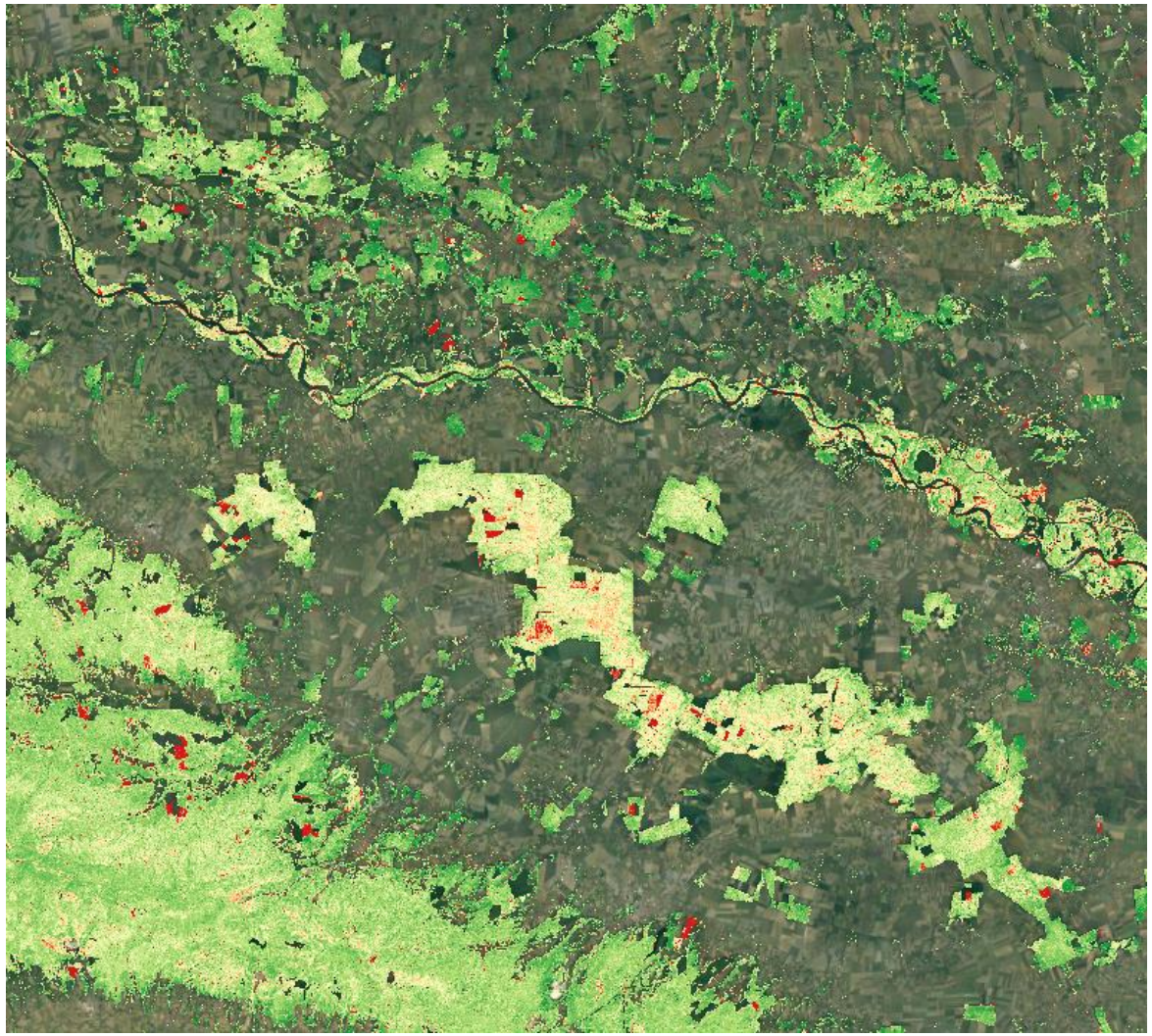
Kazalo

cd_GNDVI

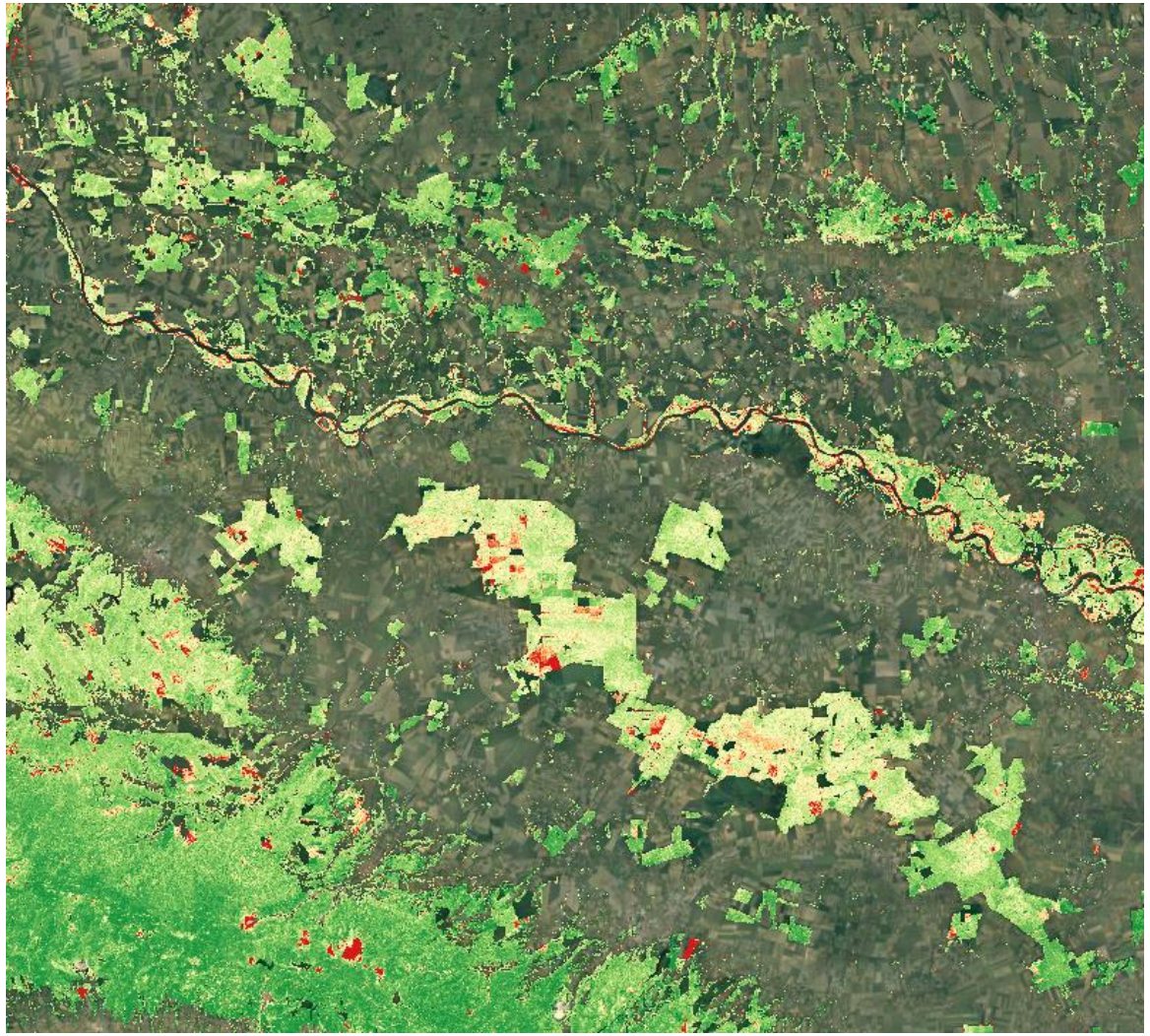
- -0.157
- -0.108
- -0.0594
- -0.0107
- 0.038

Why differences in the chlorophile content, better soil nitrogen nutrition in Hungary, cause of invasive species?

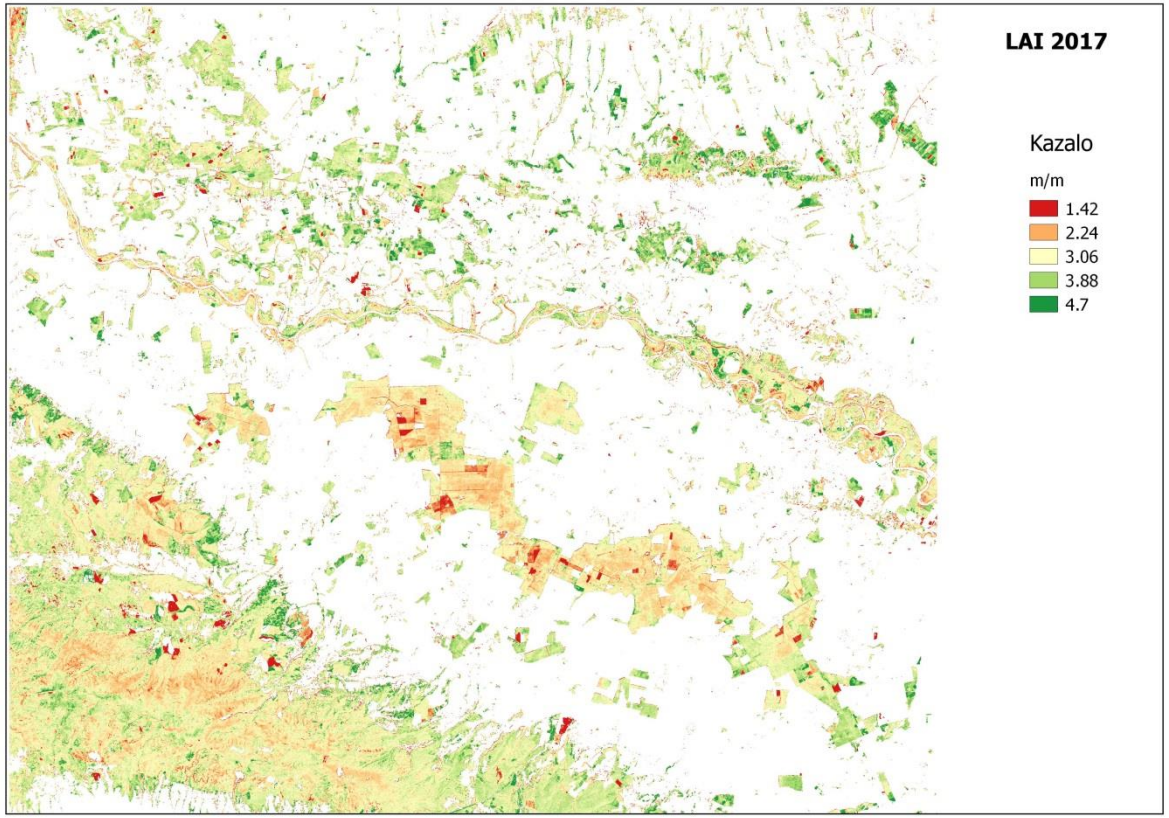
2017

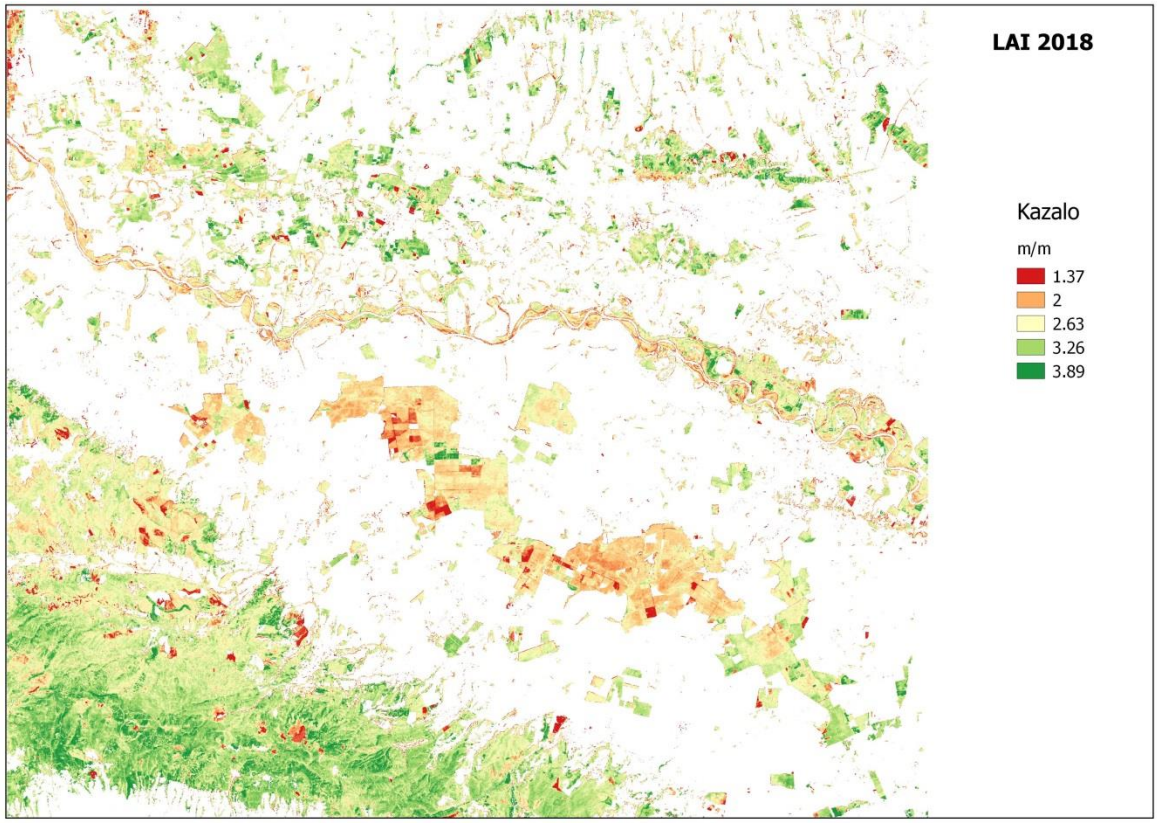


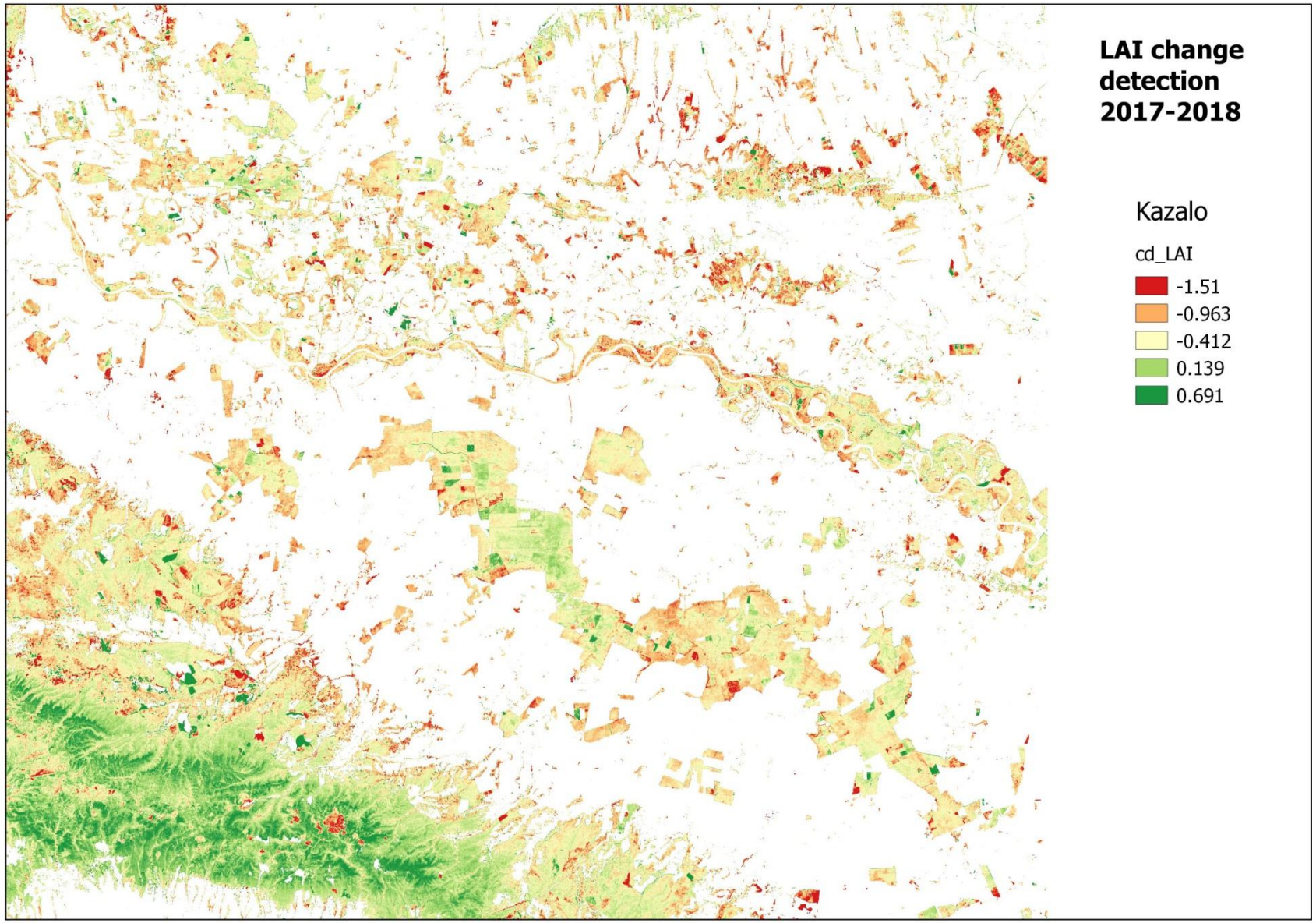
2018



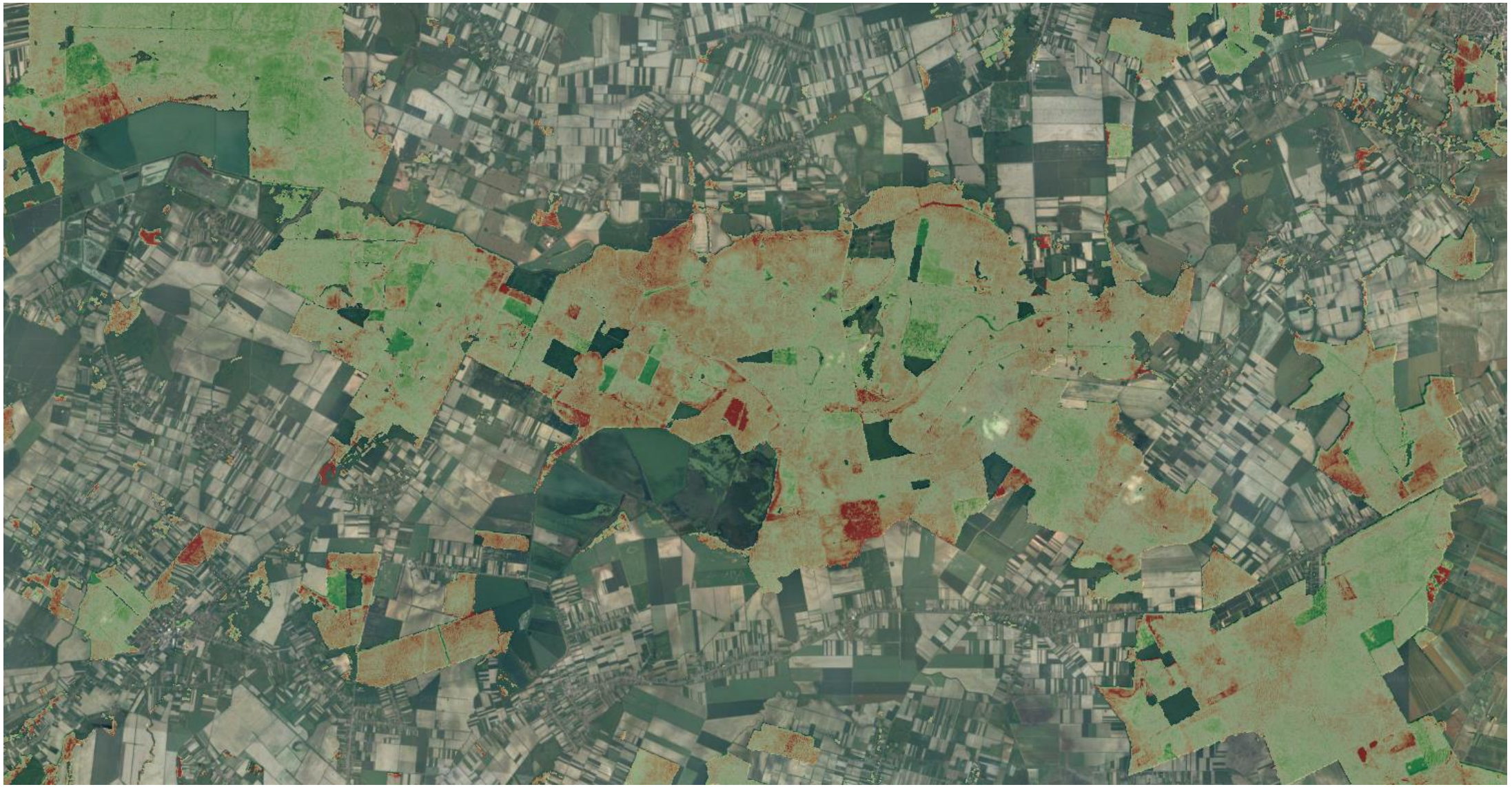
LAI – Leaf Area Index (m/m)






LAI change detection 2017-2018
Kazalo
cd_LAI
-1.51
-0.963
-0.412
0.139
0.691

Defoliation in 2018 in Koška Forest Office?



Köszönöm a figyelmet!