

# WS2 Water management and ENVIRONMENT [substantial river watersheds, catchments, dams (FG4)]

**Ivan Pilaš Croatian Forests Research Institute, Jastrebarsko**



### Hungary-Croatia

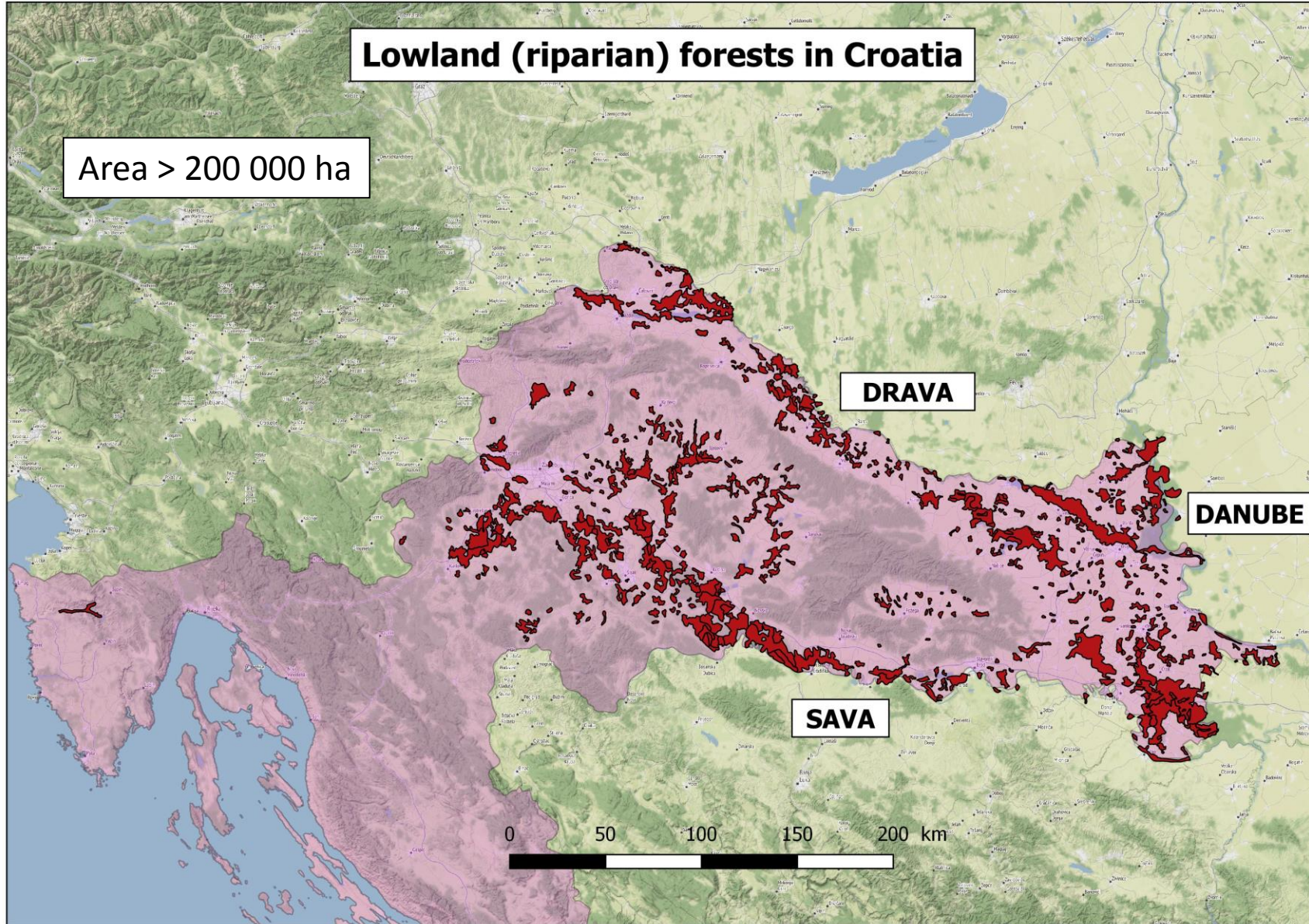
Cross-border Co-operation Programme







Hungary-Croatia  
Cross-border Co-operation Programme



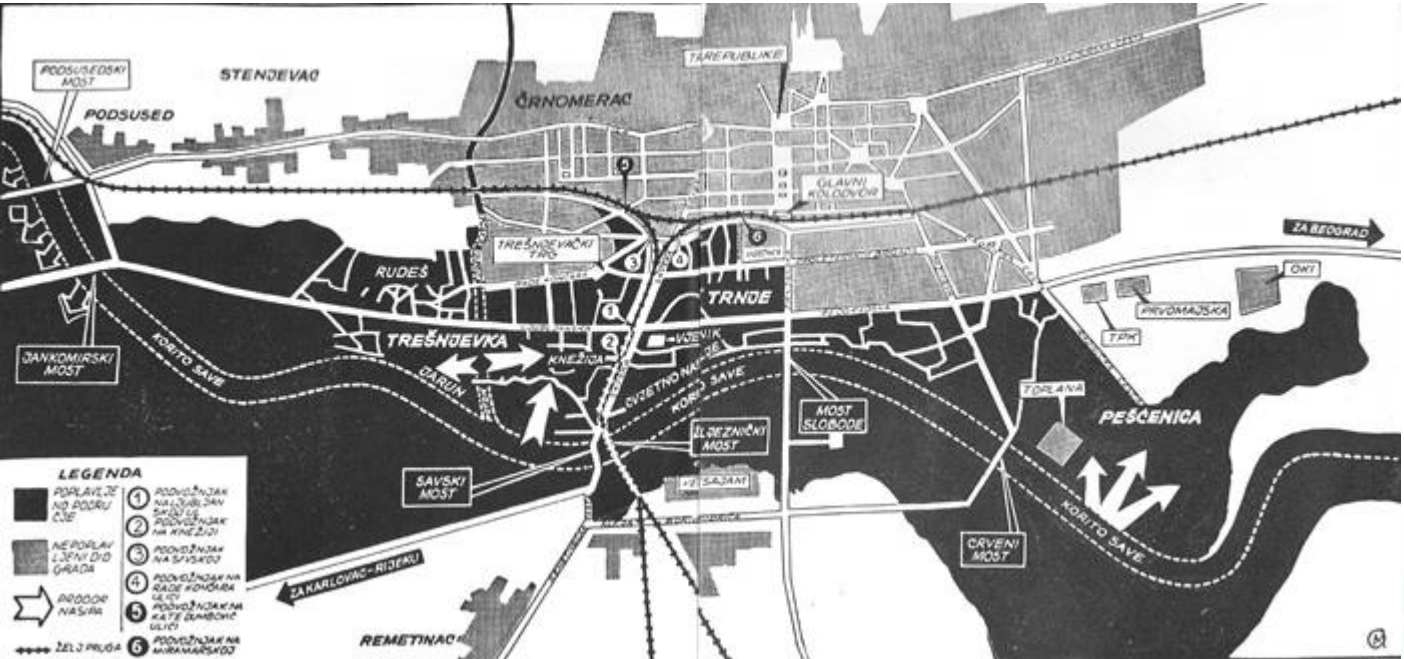
Protekt





# Development of water protection policy in Croatia

## Zagreb flood – 26.10.1964





# Consequences

- Direct impact on 180 000 citizens, 17 people died
- After the withdrawal of water, the construction of the flood defense system „Middle Posavina” initiated, within which cities threatened by flooding from Sava (Zagreb, Karlovac and Sisak) were defended by defensive floods and flood discharges.
- Initiated extensive construction works: the use of natural areas and lowland forests along river as a flood retention areas, construction of embankments along the settlements, canalization of rivers...

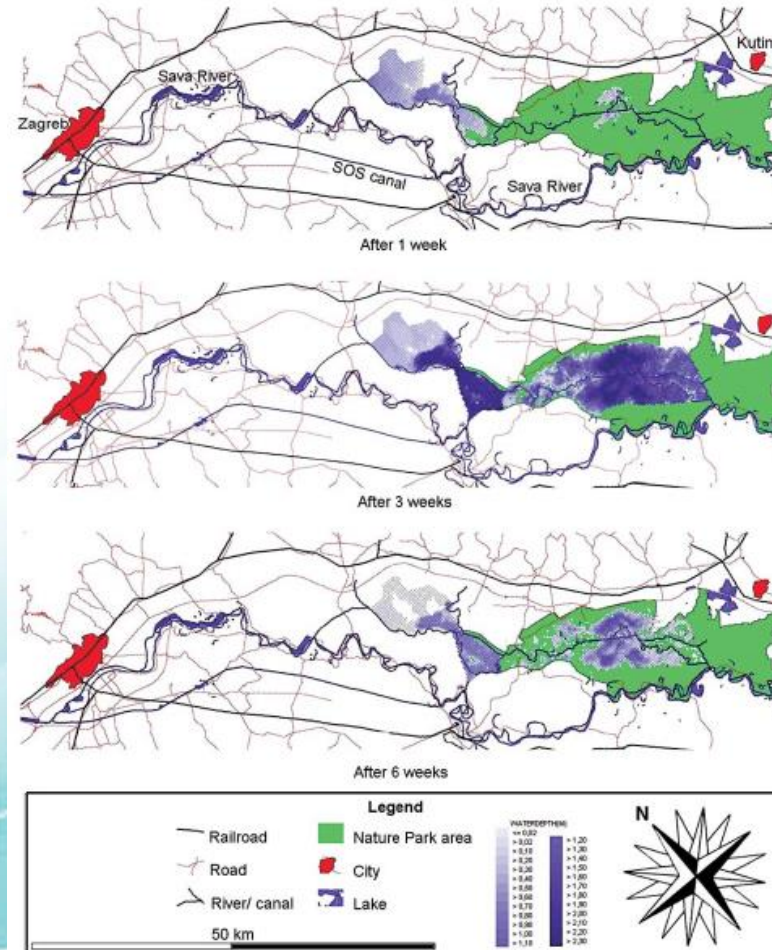


# Flood defense system „Middle Posavina” – Use of the riparian lowland forests like flood retention areas



Nature park Lonjsko polje 237 km<sup>2</sup>

Flooding of Lonjsko Polje (1:100 yr event)











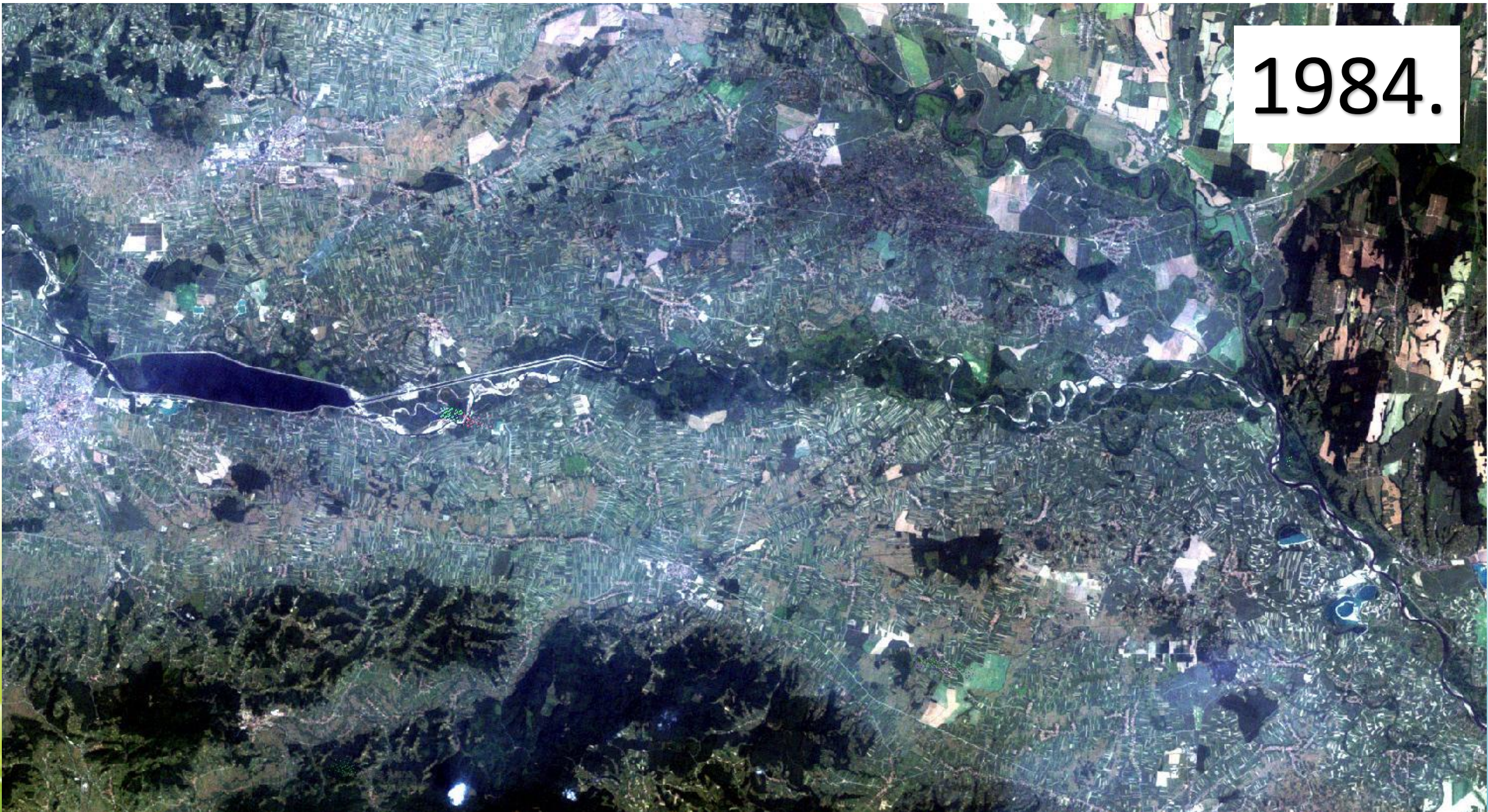


# Drava river basin – constructed reservoirs and HP plants



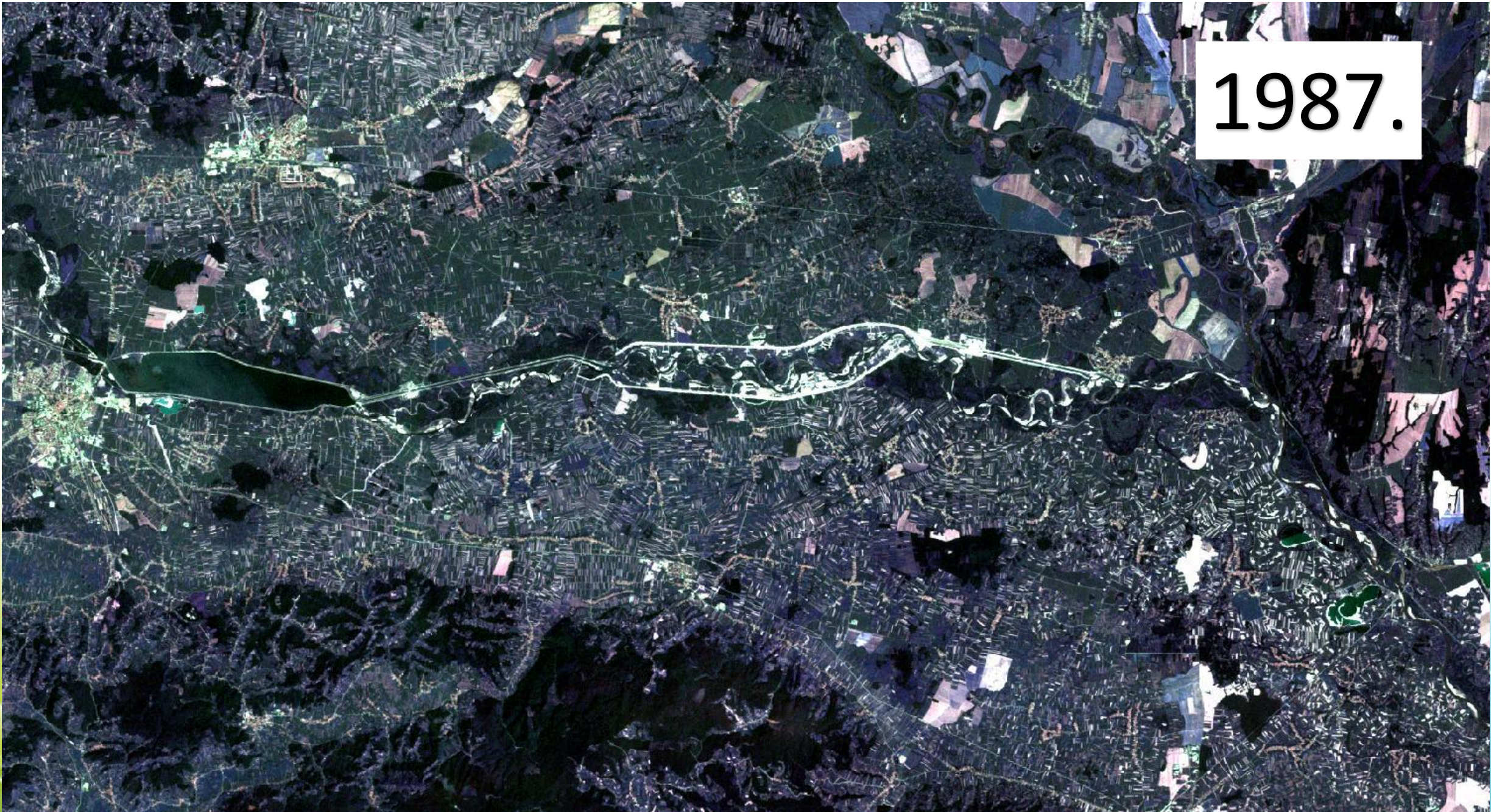


1984.





1987.





1994.





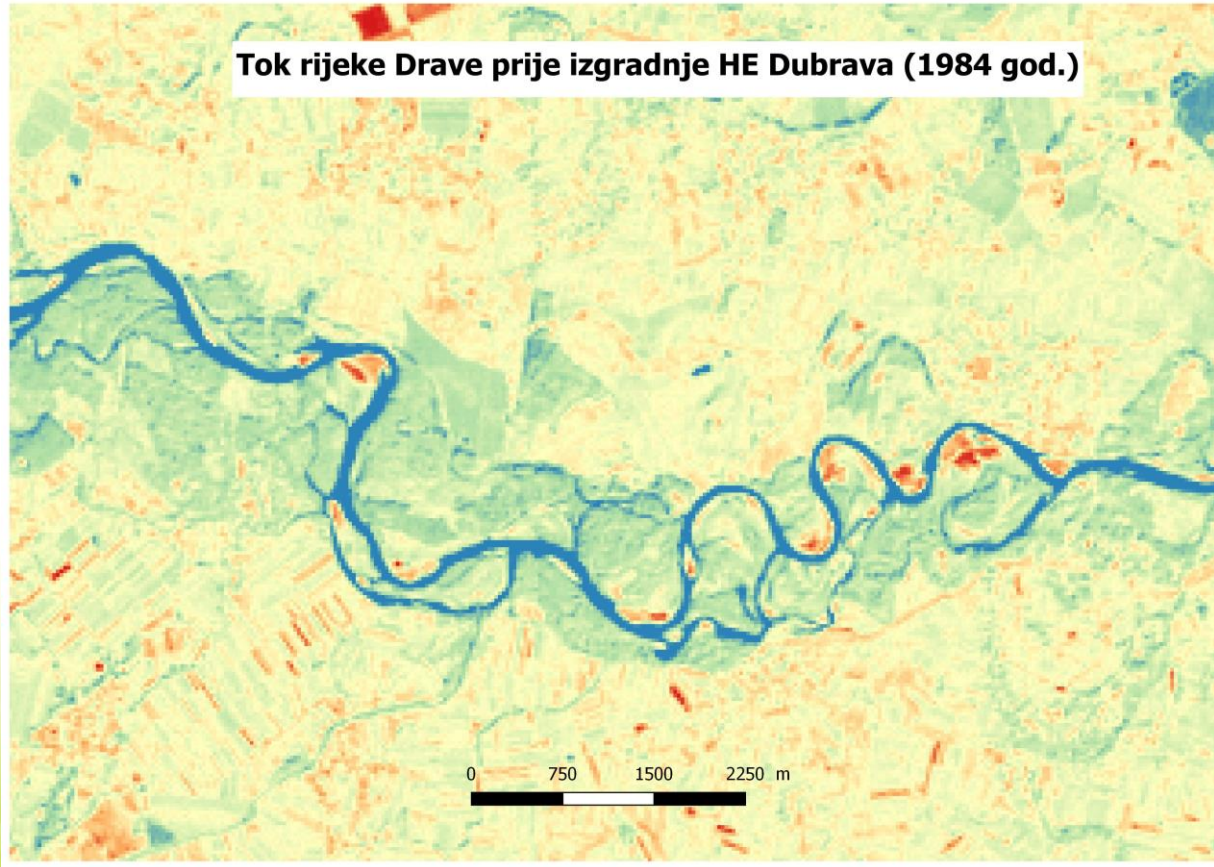
2011.



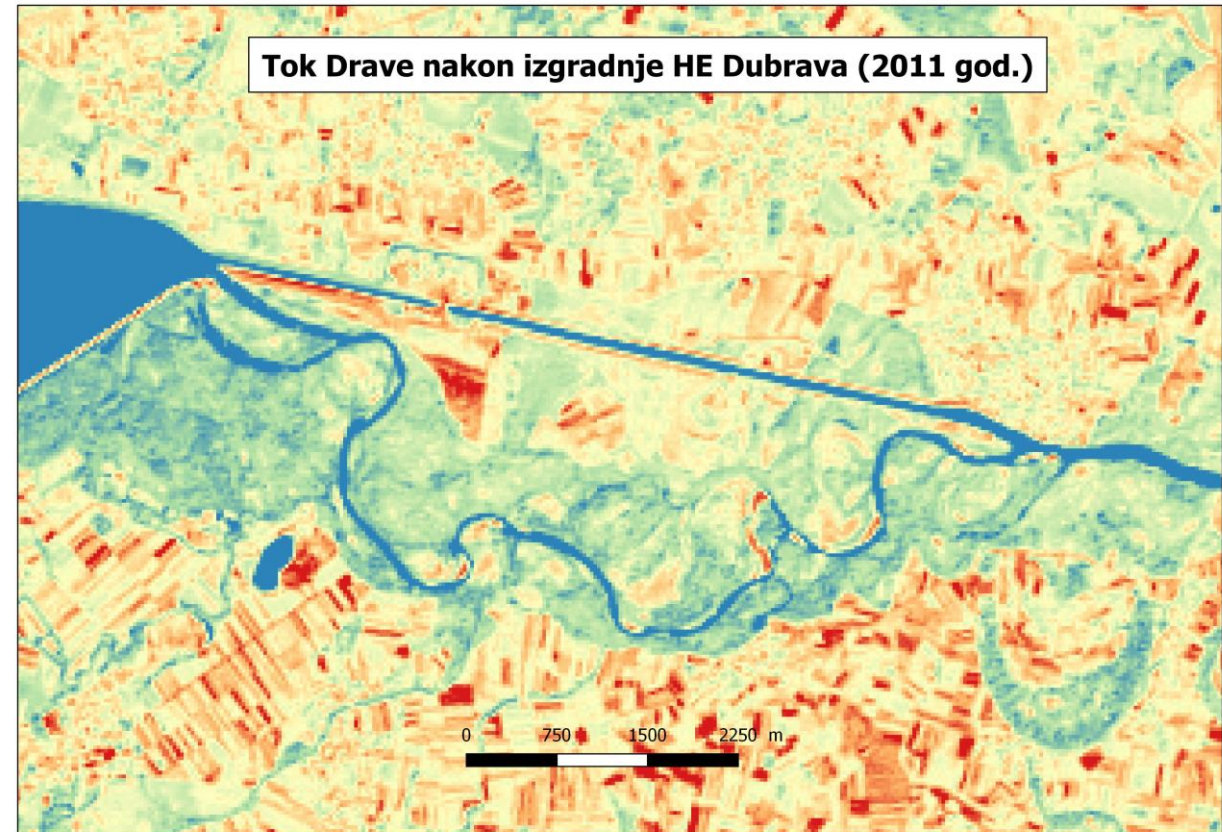


# Utjecaj izgradnje HE Dubrava na promjenu nizvodnog toka rijeke Drave

Tok rijeke Drave prije izgradnje HE Dubrava (1984 god.)



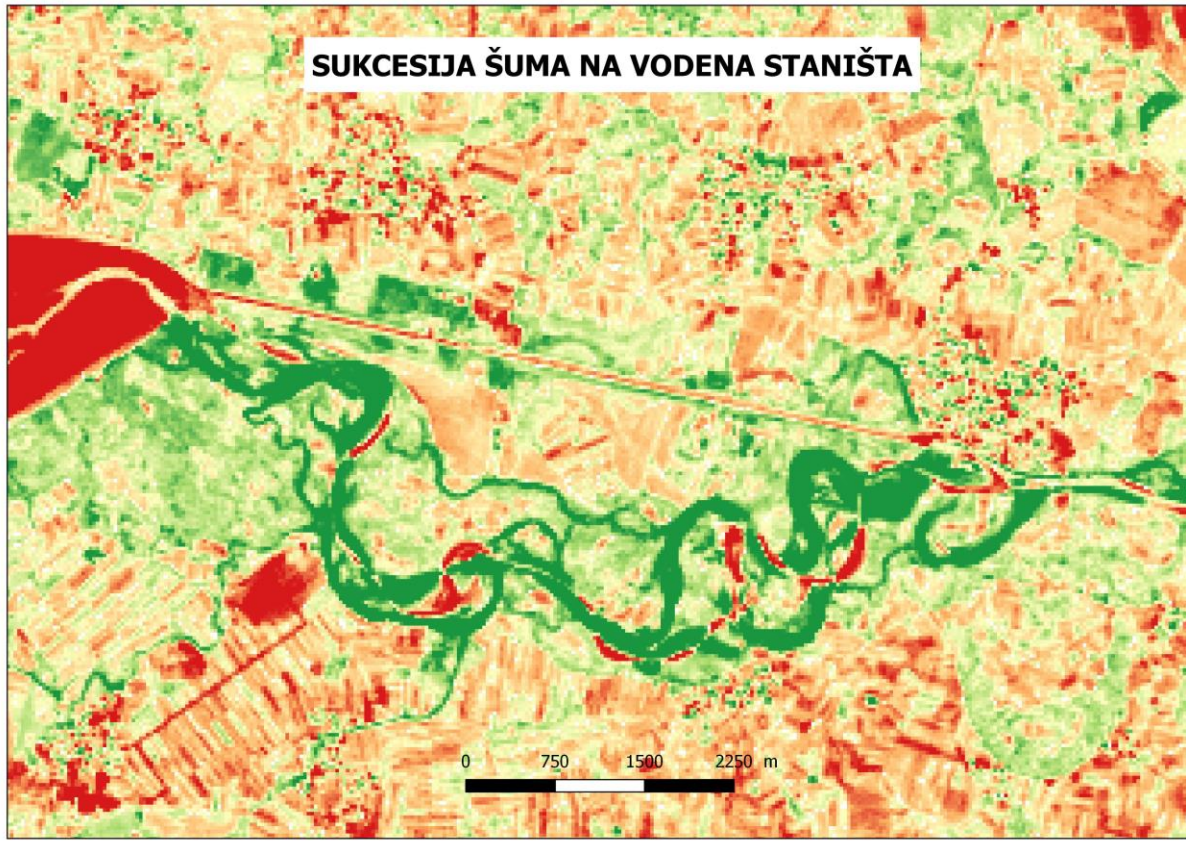
Tok Drave nakon izgradnje HE Dubrava (2011 god.)



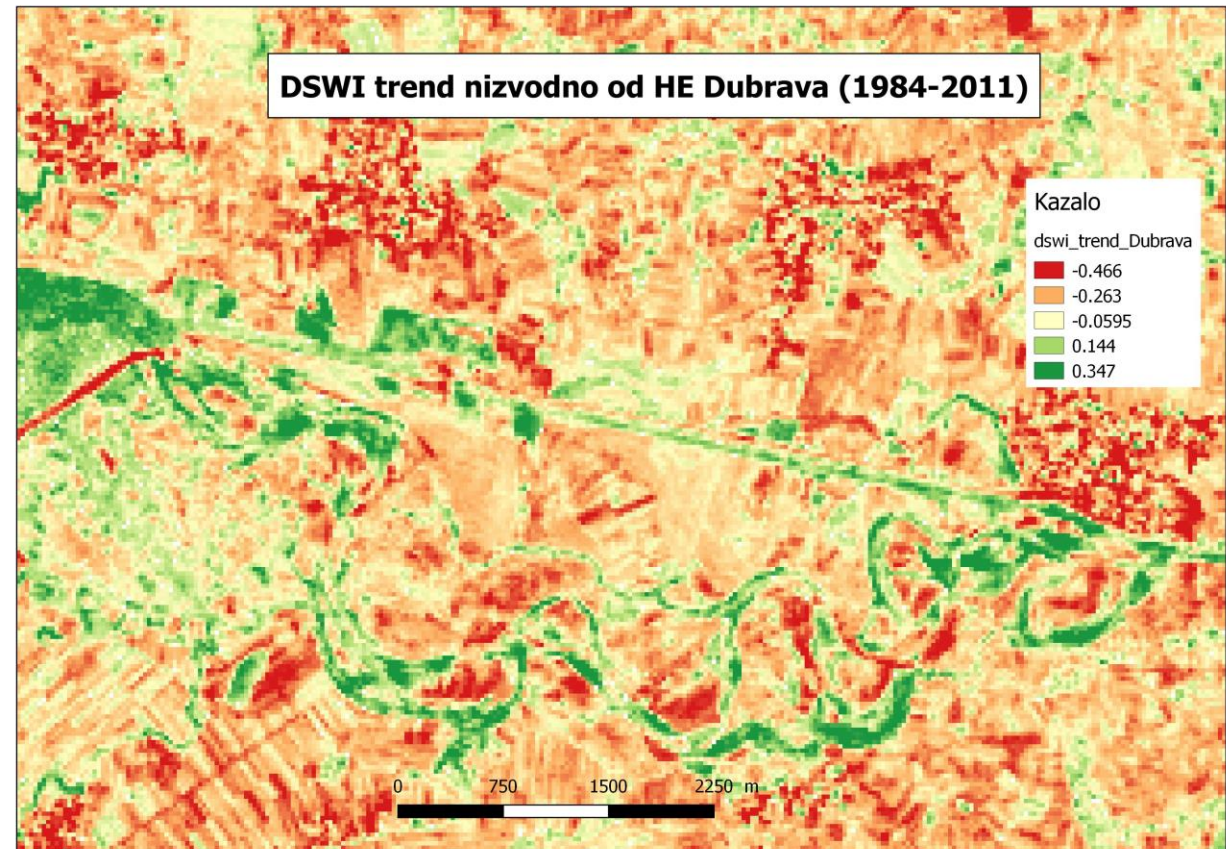


# Utjecaj izgradnje HE Dubrava na šumsku vegetaciju nizvodno od akumulacije

NDVI – Normalized difference vegetation index

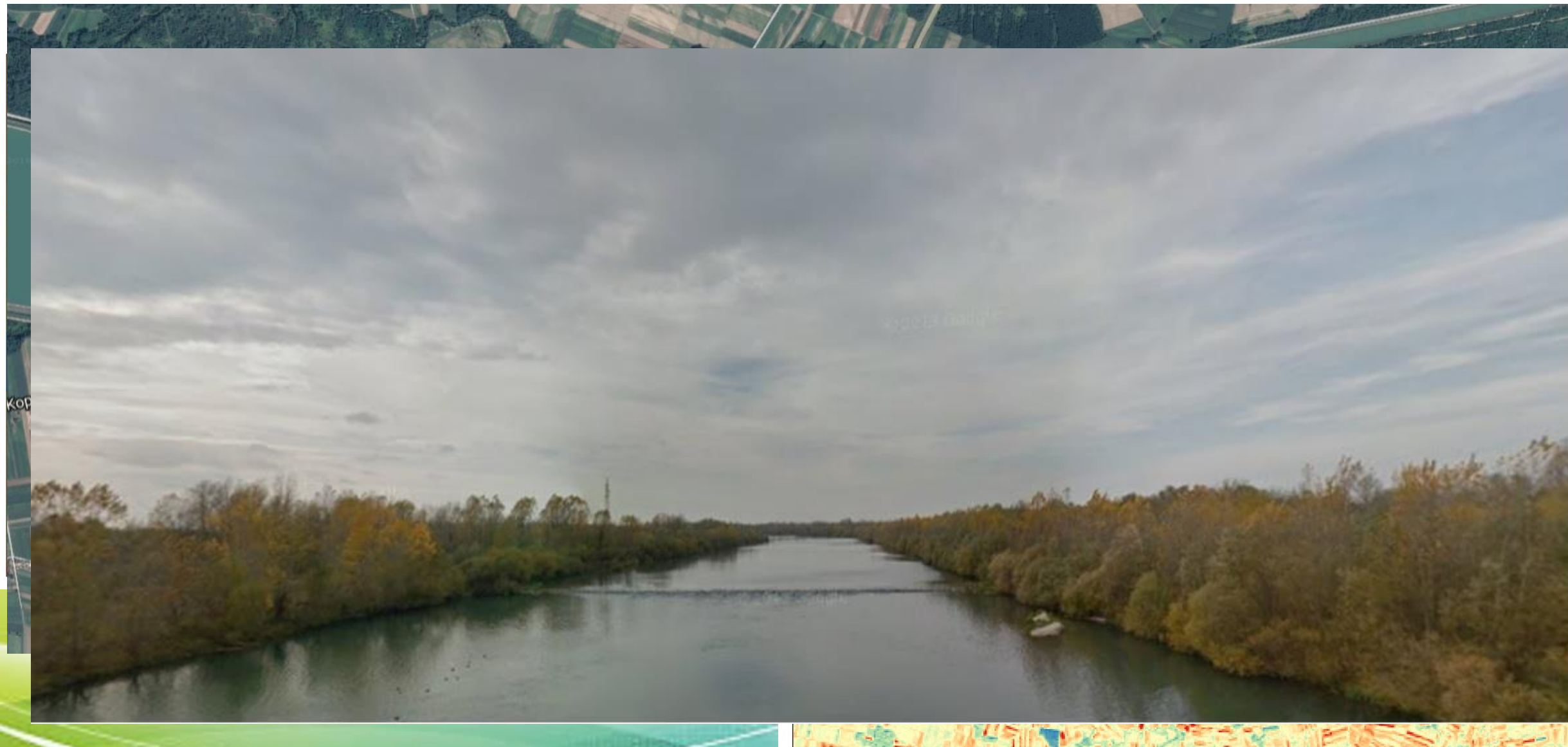


DSWI – Disease water stress index





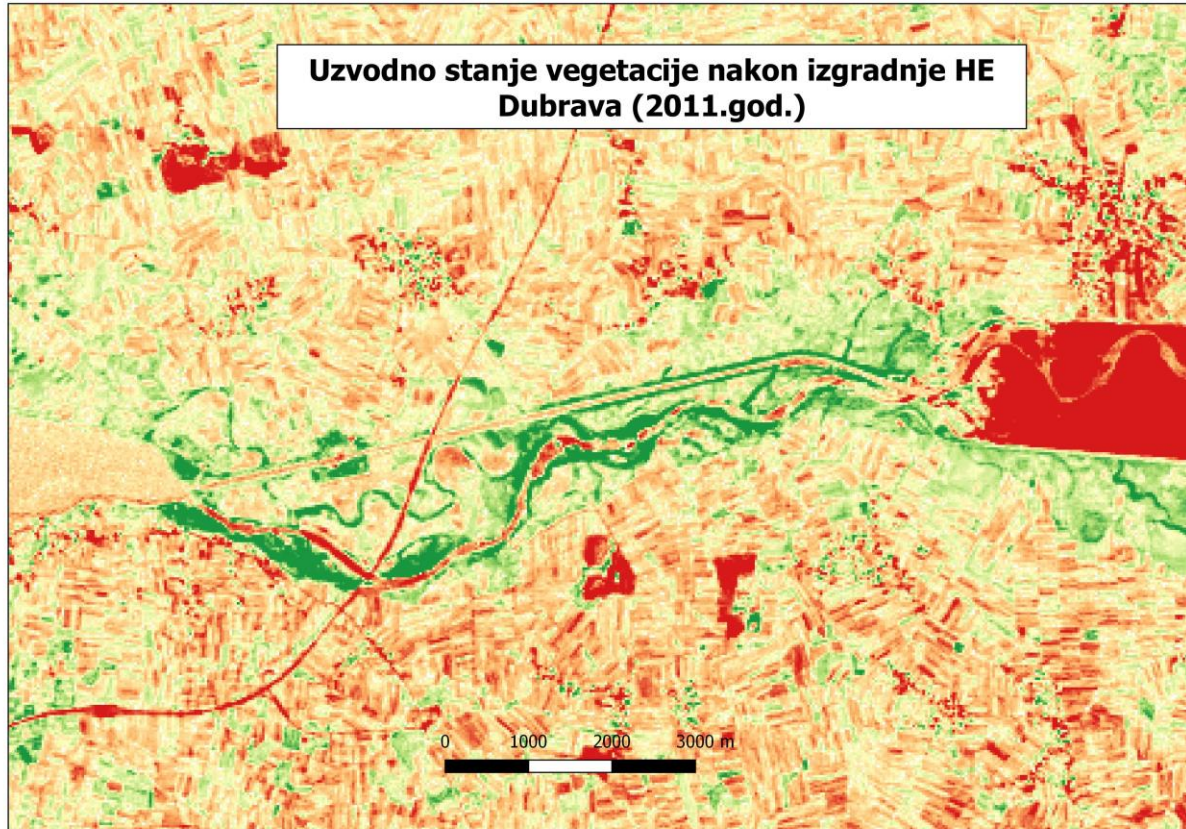
# Utjecaj izgradnje HE Dubrava na promjenu uzvodnog toka rijeke Drave



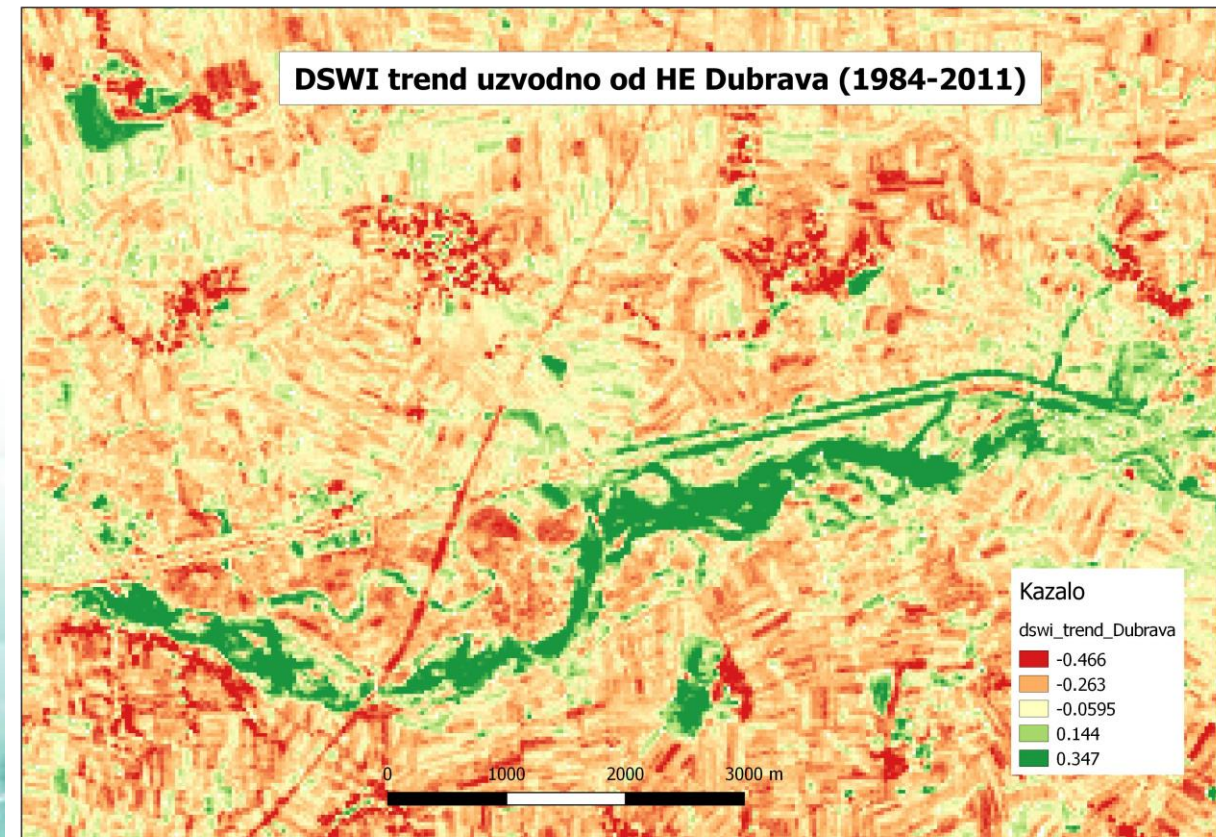


# Utjecaj izgradnje HE Dubrava na šumsku vegetaciju nizvodno od akumulacije

NDVI – Normalized difference vegetation index



DSWI – Disease water stress index



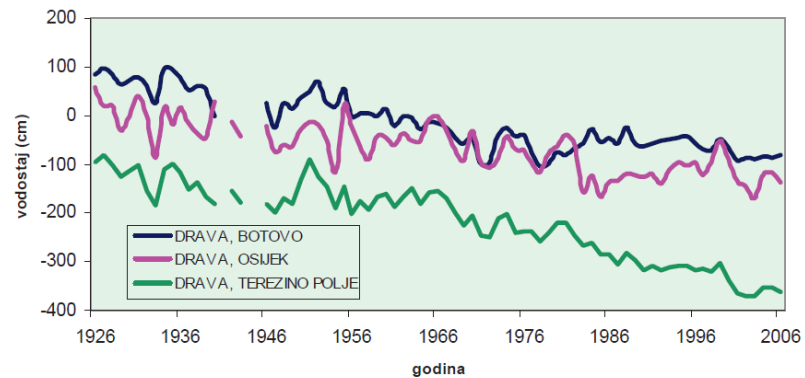


# Protection of the English oak in the crossborder area 'Oak protection'



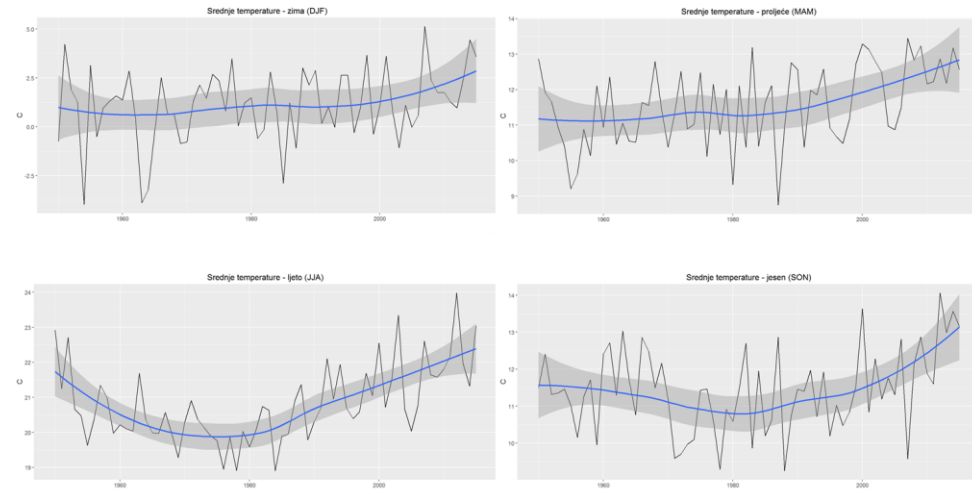
# Hydro-climatic changes in the region (*summer-autumn desiccation, increased runoff and more extreme precipitation, lowering of winter groundwater recharge due to snow reduction and Drava riverbed erosion!*)

## Trends of minimal Drava waterlevels

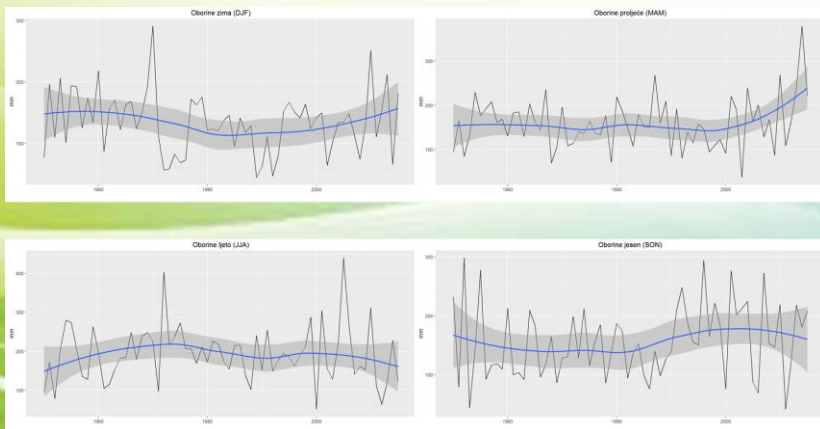


Slika 2.5. Vremenski nizovi najnižih godišnjih vodostaja zabilježenih na karakterističnim stanicama na Dravi

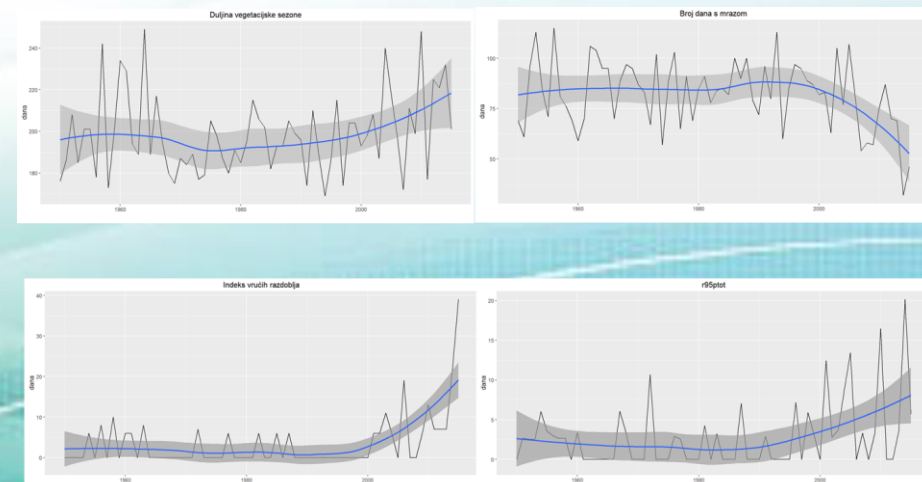
## Seasonal temperature trends



## Seasonal precipitation trends



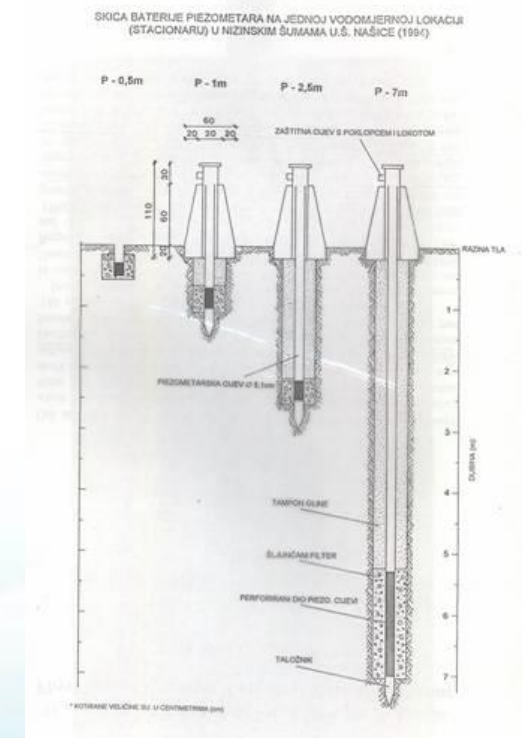
## Indices of climatic extremes





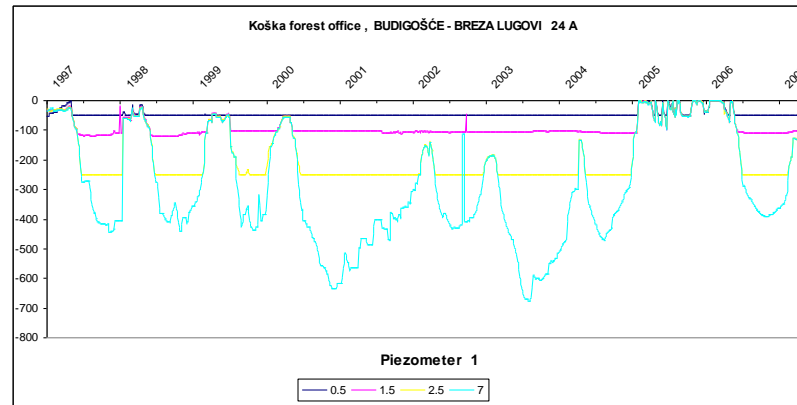
# Groundwater monitoring system with piezometric pipes and data collection (1981)

- In the creation of a database and information on groundwater suitable for scientific and technical discussions on the planning and construction of new hydro-technical constructions (canals, accumulations)
- In assessing the critical value of hydrological parameters important to preserve the stability of lowland forests
- In evaluating the importance of water over other causal factors of forest dieback

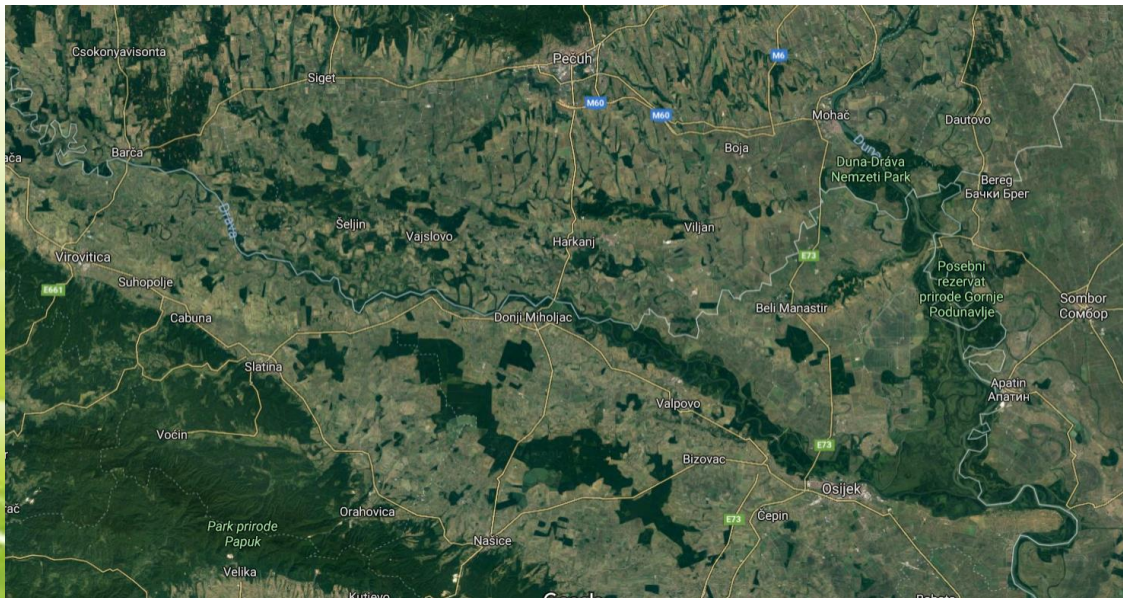




# Project motivation – Observed Rapid decline of Groundwater tables after 2000!



## YEARLY DROP OF GROUNDWATER TABLES FROM AVERAGES, 1997-2015

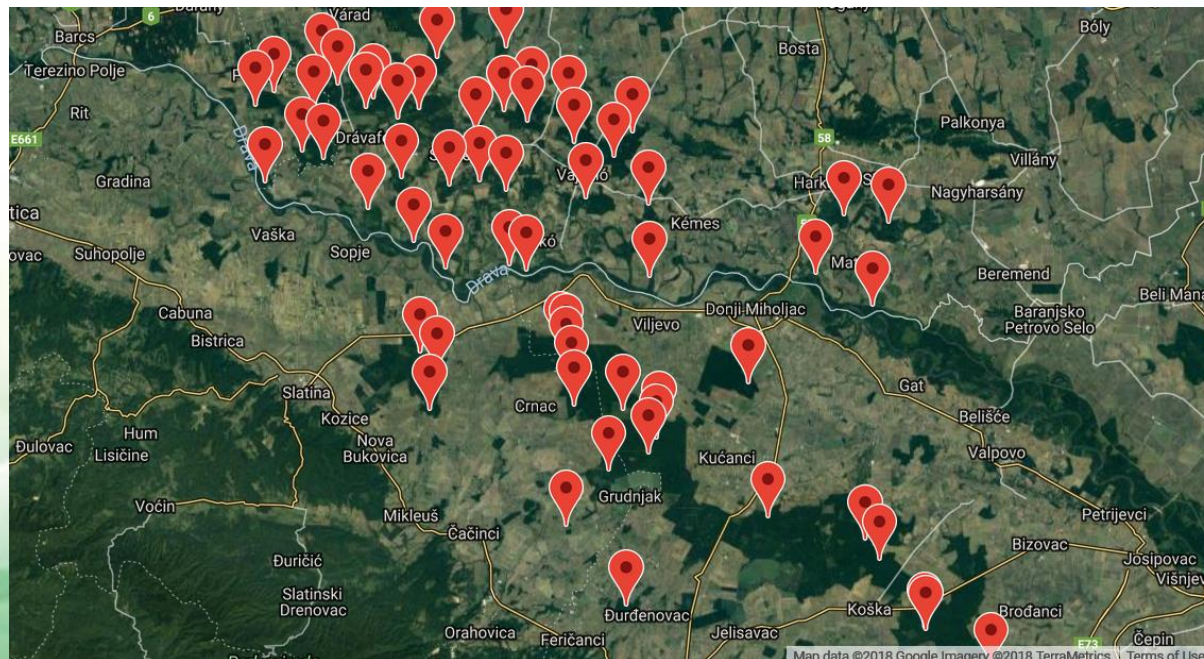




# The hydrological objectives of the Oak protection project:

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

- monitoring of the present and future hydrologic changes and assessment of ecosystems suitability for *Quercus robur*







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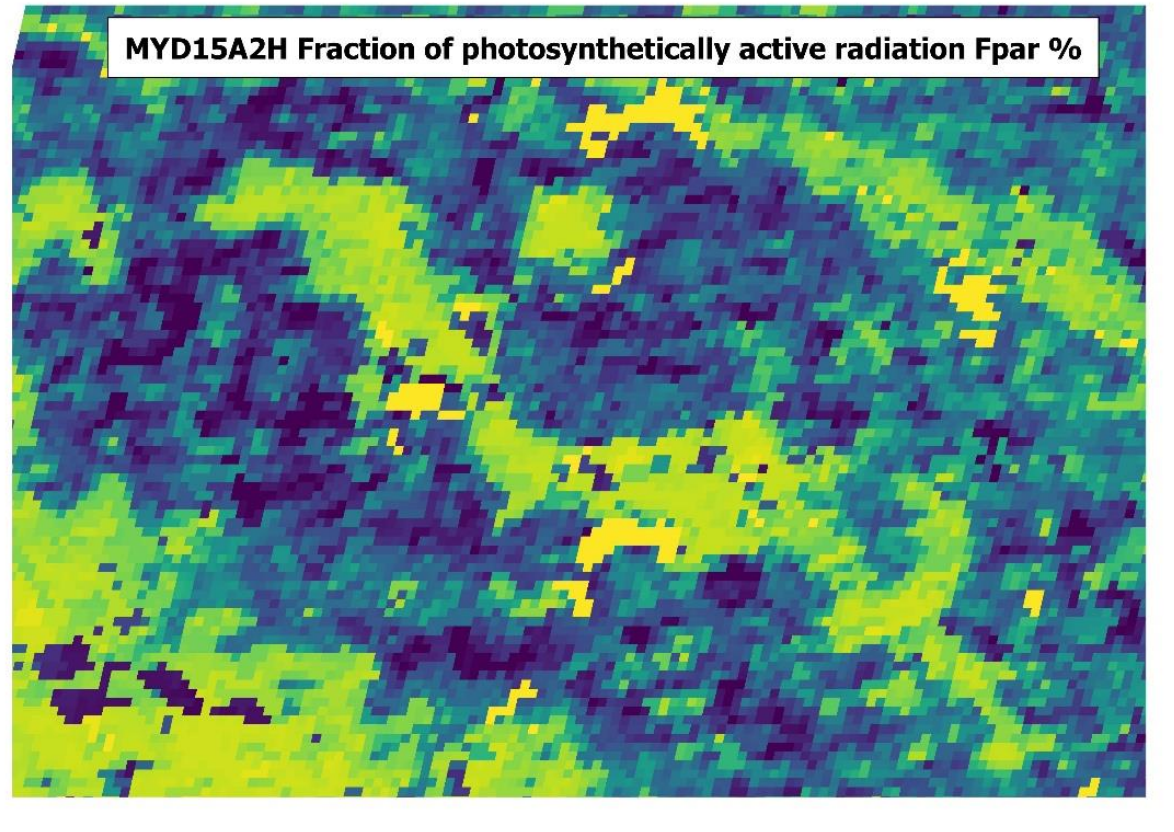
# Aims of the

The main goal is to pr





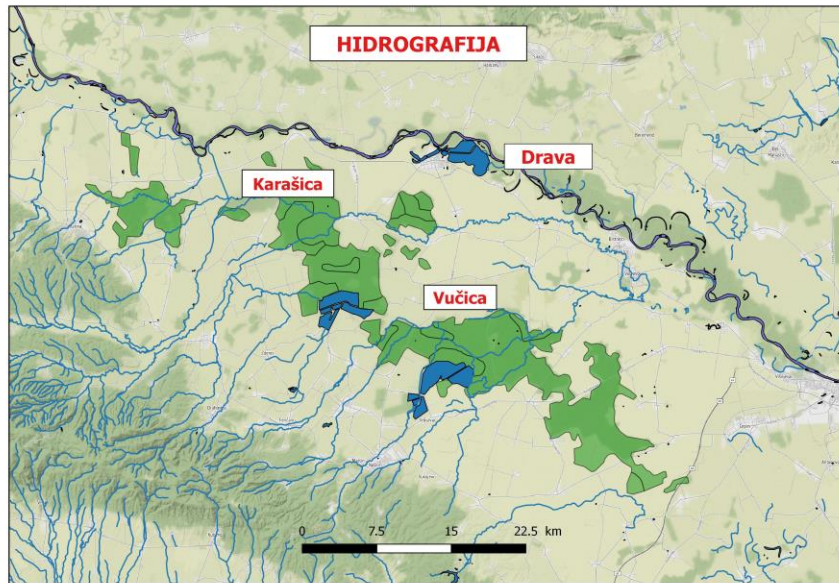
## II) Real time climate monitoring and the drought early warning system (Web-Gis)





### III) Evaluation and proposal of adaptive forest-water retention measures, based on Lidar topography, to enhance ecosystem stability

- Detail microtopographic assessment – LIDAR
- Groundwater management – measures to retain water in the landscape and recharge groundwater tables (DRAINMOD, 1D, 3D models)
- Flood management – establishment of sustainable flooding regime (reducing of flood duration and prolonged accumulation of surface water)







**My  
Sustainable  
Forest**

Earth observation services for silviculture

MySF Forest condition (monitoring) service -  
conceptual overview of SAR (Sentinel 1)  
Polarimetry application  
Ivan Pilaš - CFRI

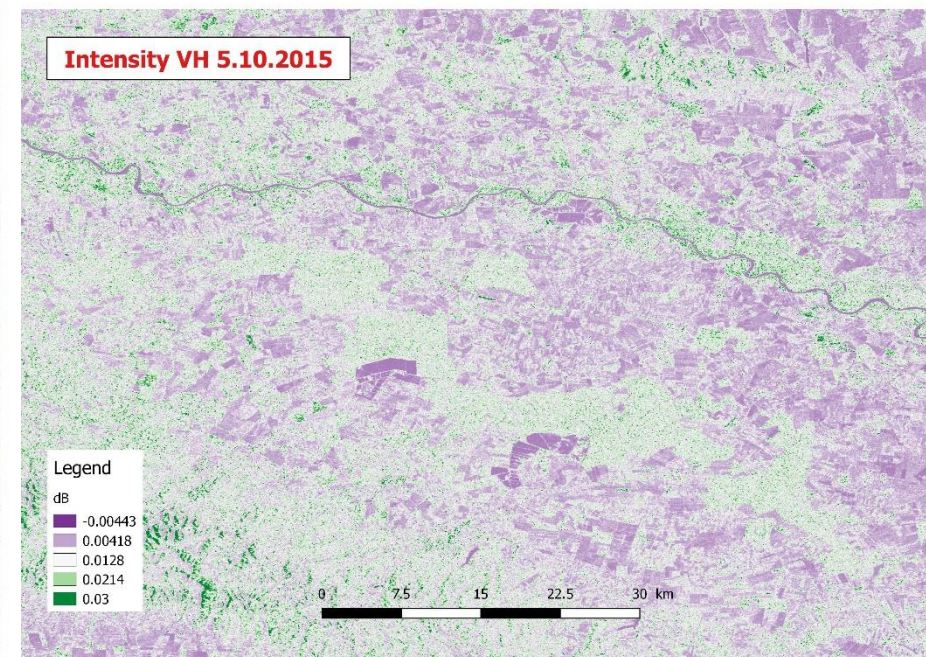
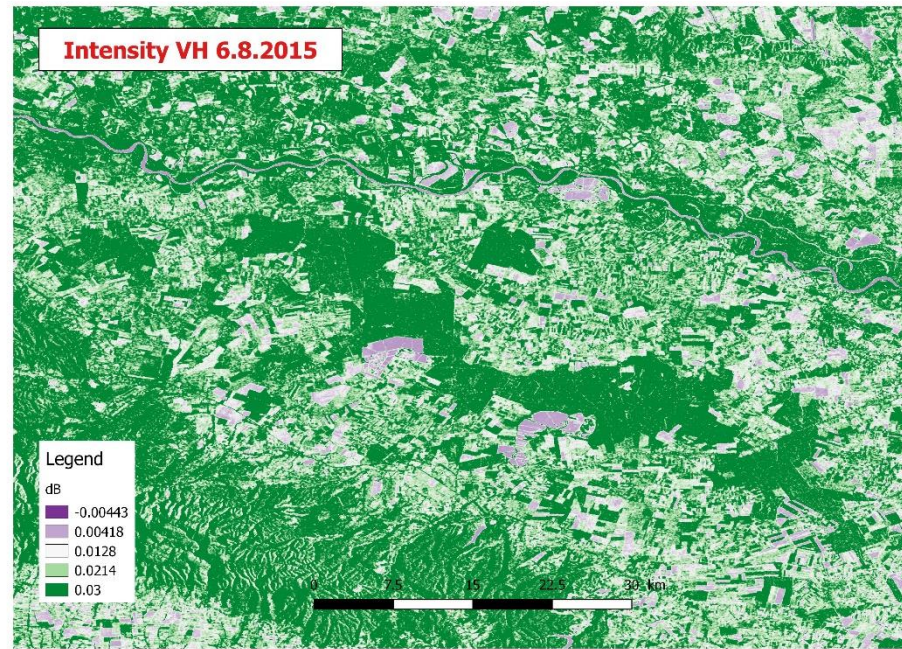
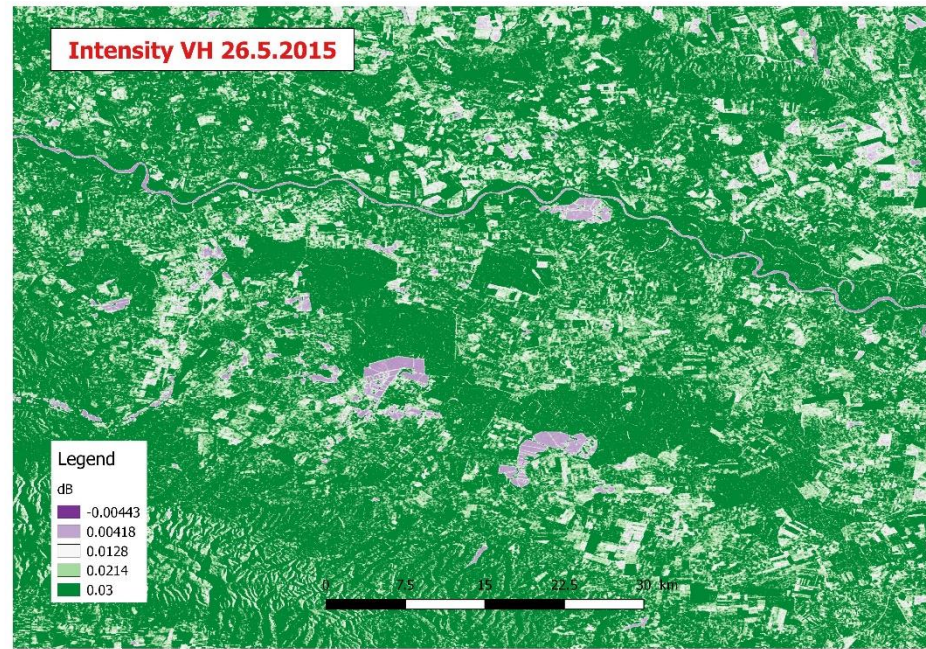
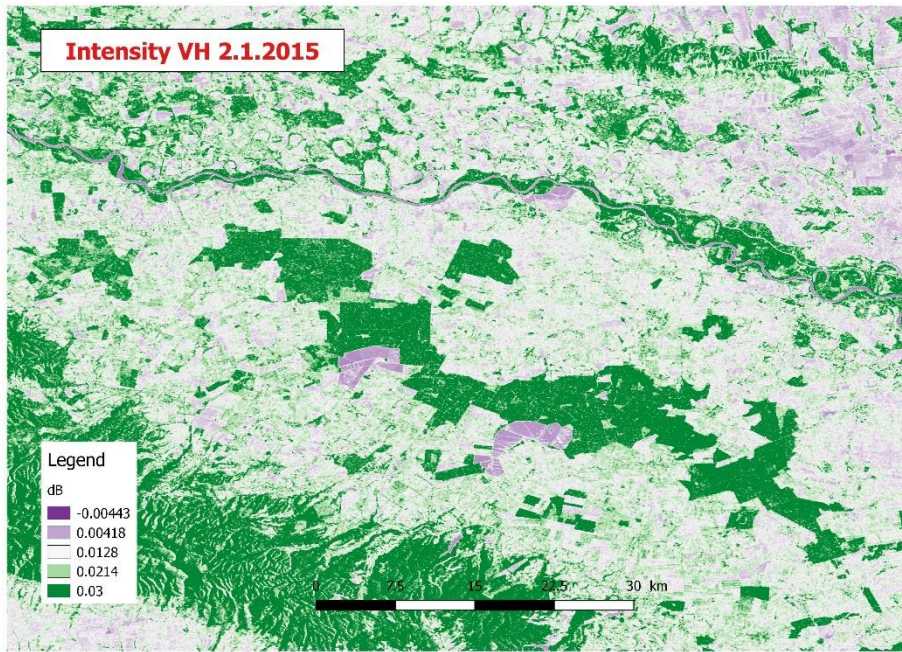




# Sentinel 1 polarimetry data

- 22 S1A products for 2015 (2.1. – 15.12.) from Copernicus Open Acces Hub (<https://scihub.copernicus.eu/>)
- Interferometric Wide (IW) swath SLC dual polarisation (VV+VH) layers
- Processing in SNAP application (Calibration, TOPSAR Deburst, Multilook, Speckle Filter, Terrain Correction) and R







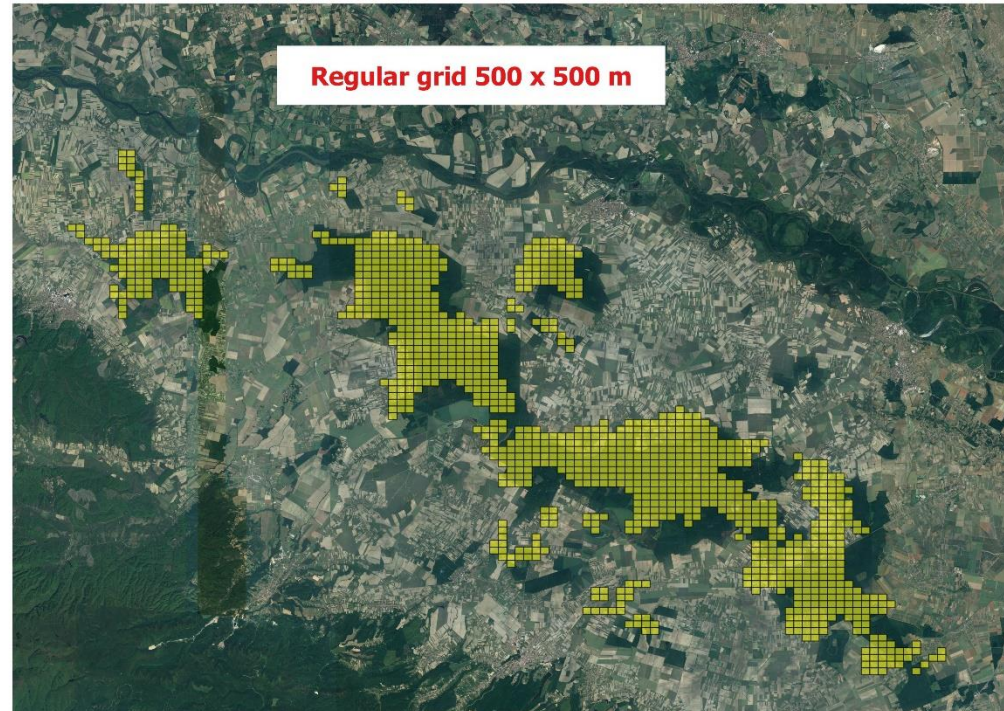
# The meaning of the polarimetry dB values?

## **MOD17A2H - MODIS/TERRA Gross Primary Productivity 8-Day 500m**

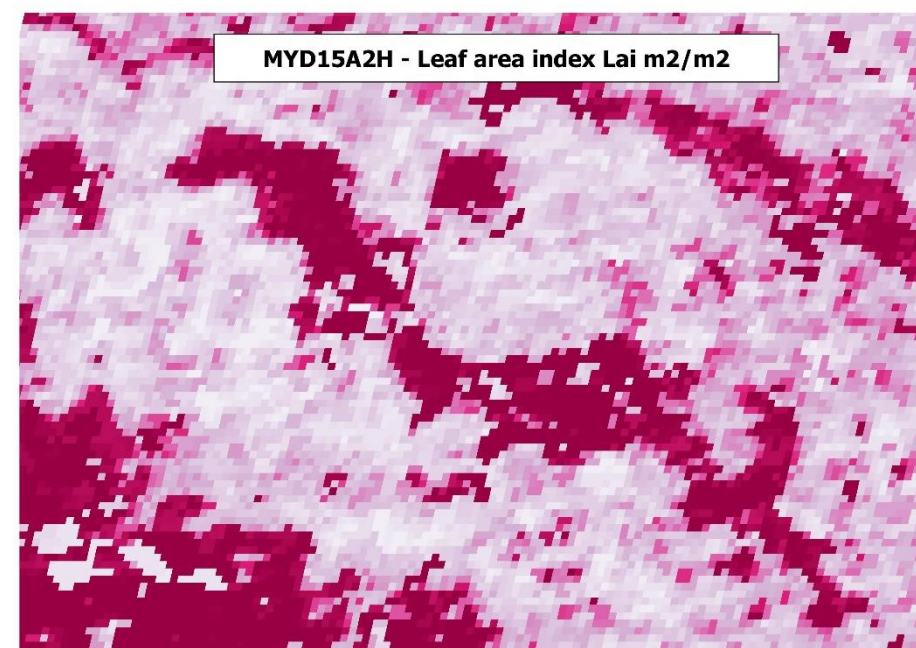
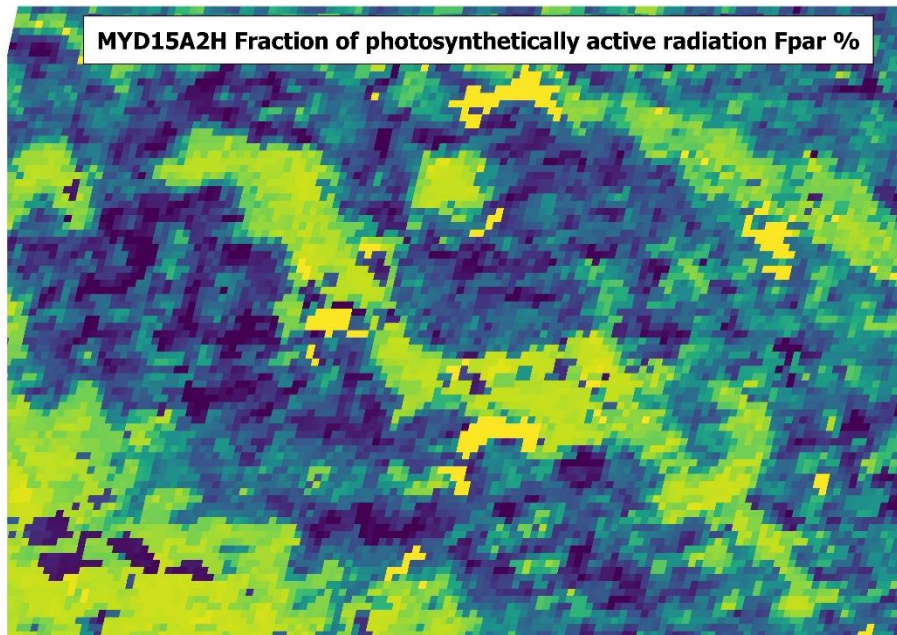
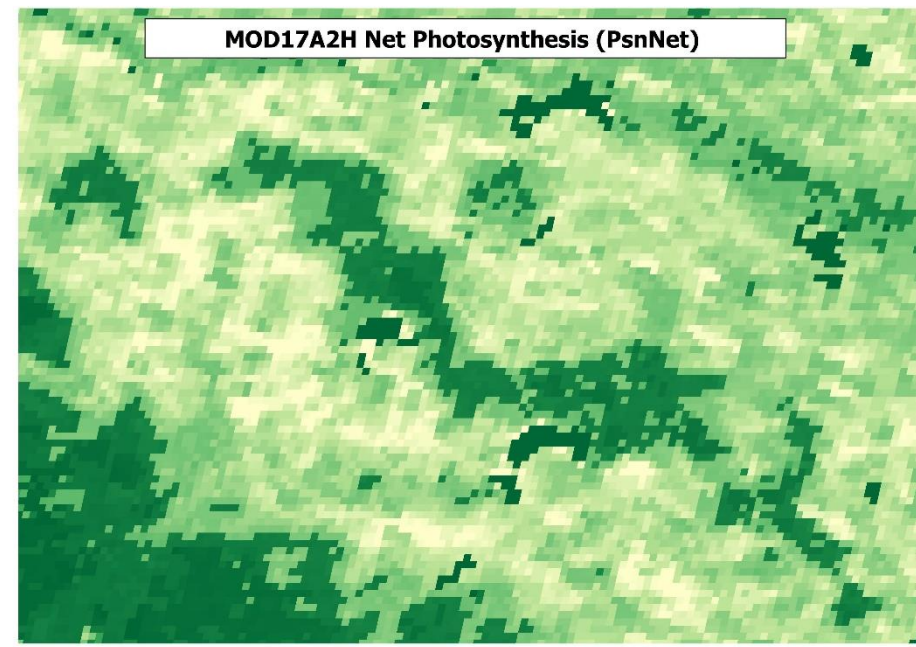
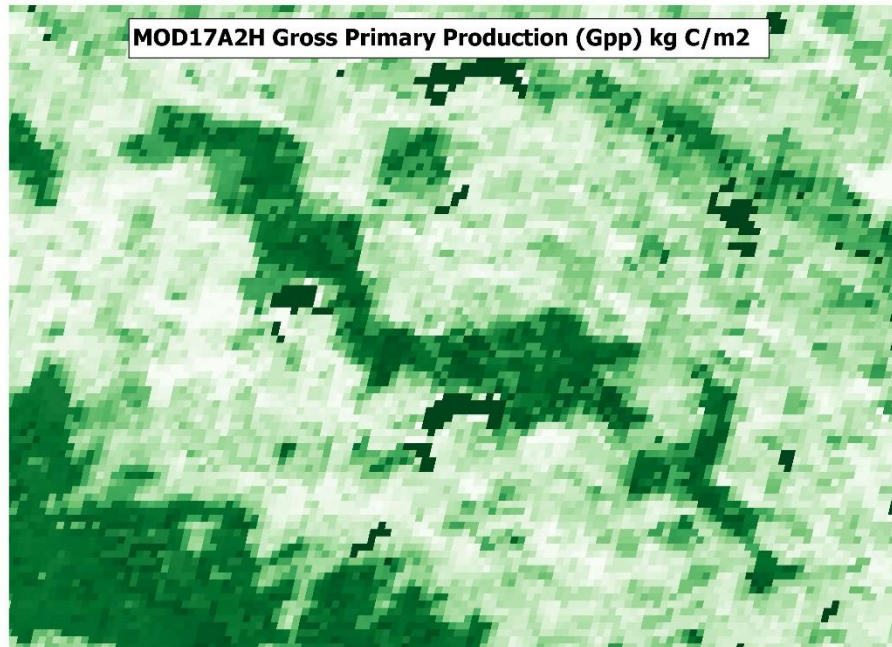
- Gross Primary Production (Gpp) kg C/m<sup>2</sup>
- Net Photosynthesis (PsnNet) GPP-MR

## **MYD15A2H: MODIS/AQUA Leaf Area Index/FPAR 8-Day L4 Global 500m**

- Fraction of photosynthetically active radiation Fpar %
- Leaf area index Lai m<sup>2</sup>/m<sup>2</sup>

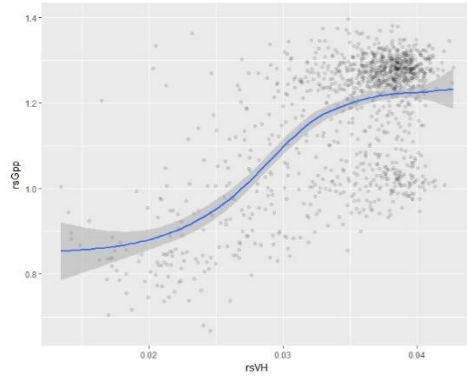




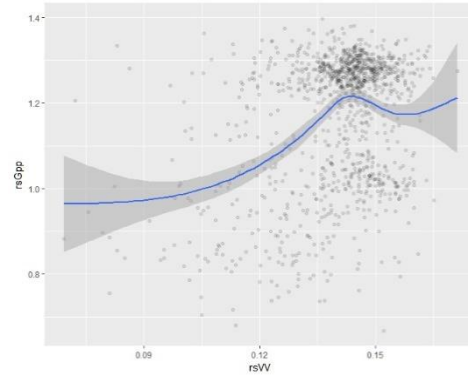




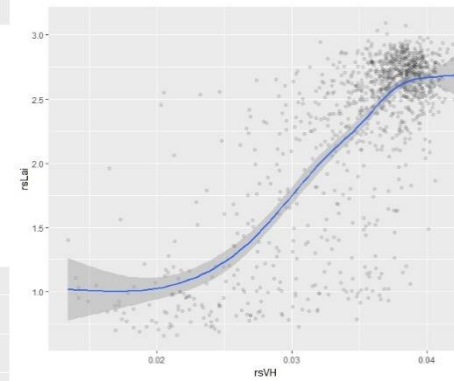
VH - Gpp



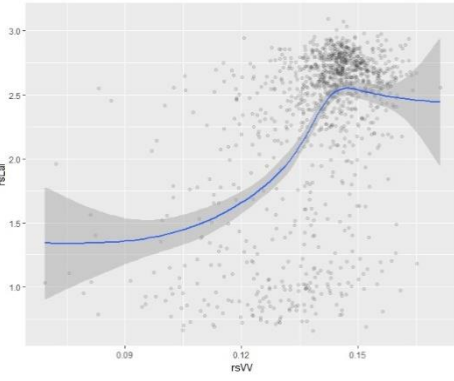
VV - Gpp



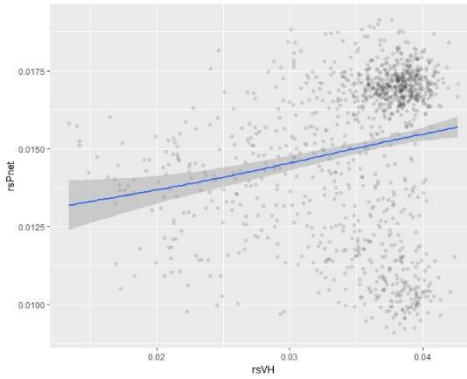
VH - Lai



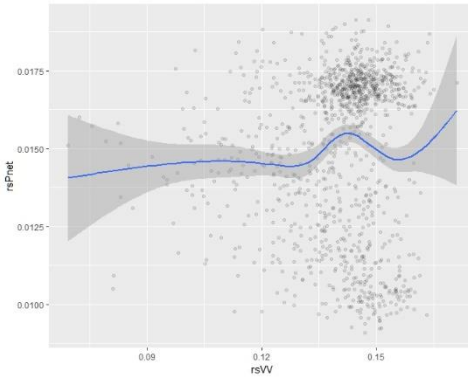
VV - Lai



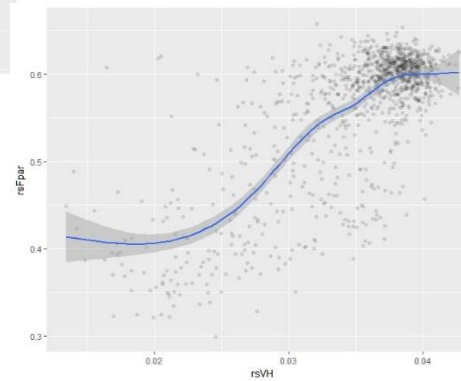
VH - PsNet



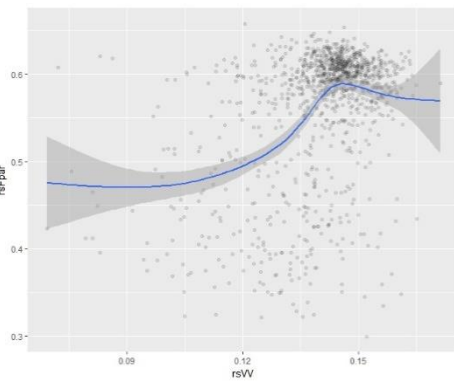
VV - PsNet



VH - Fpar

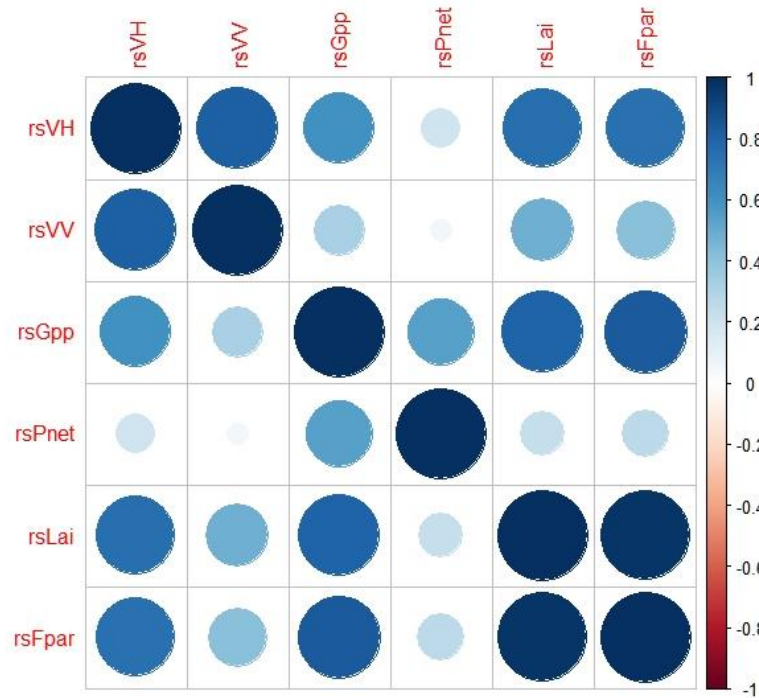


VV - Fpar

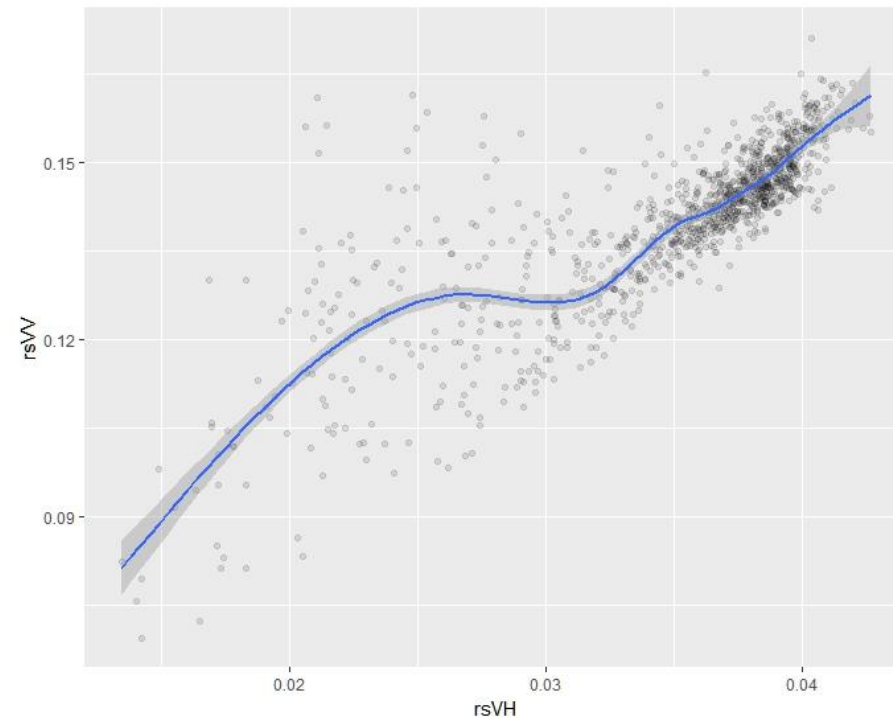




## Correlation matrix

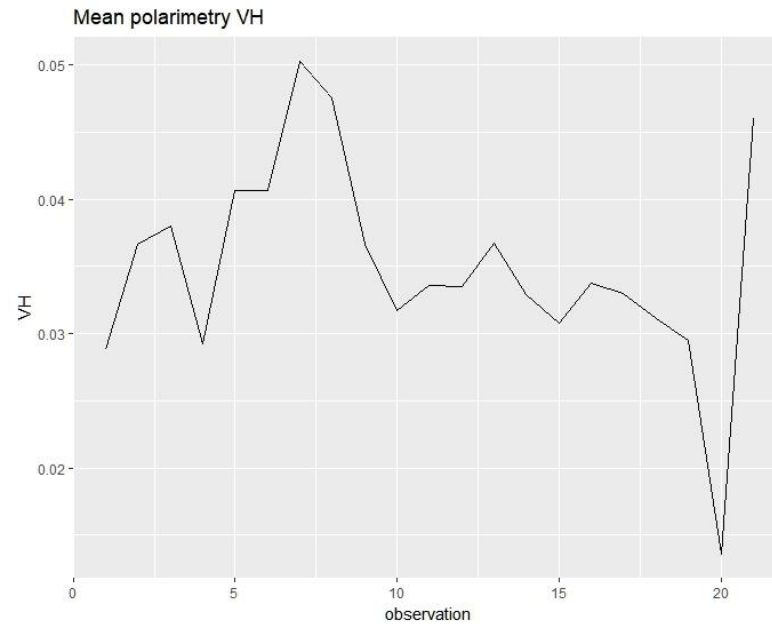
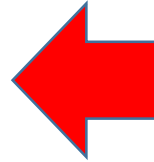


- High significant positive relationship between **VH** and **Gpp,Lai and Fpar**
- High correlation of VH and VV only in **higher value range**

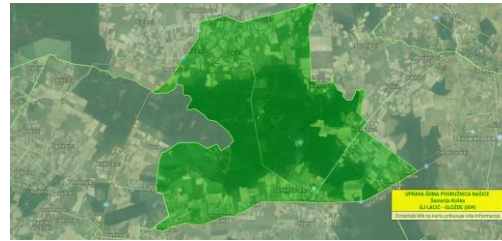
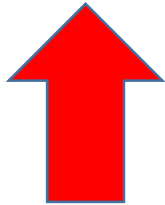




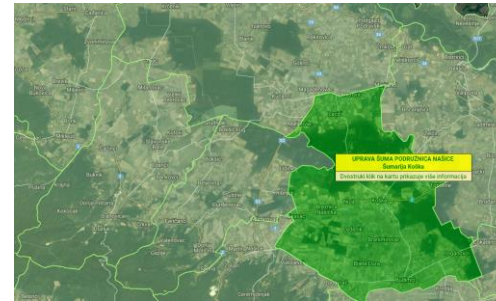
## Forest compartement/subcompartement (>3 ha)



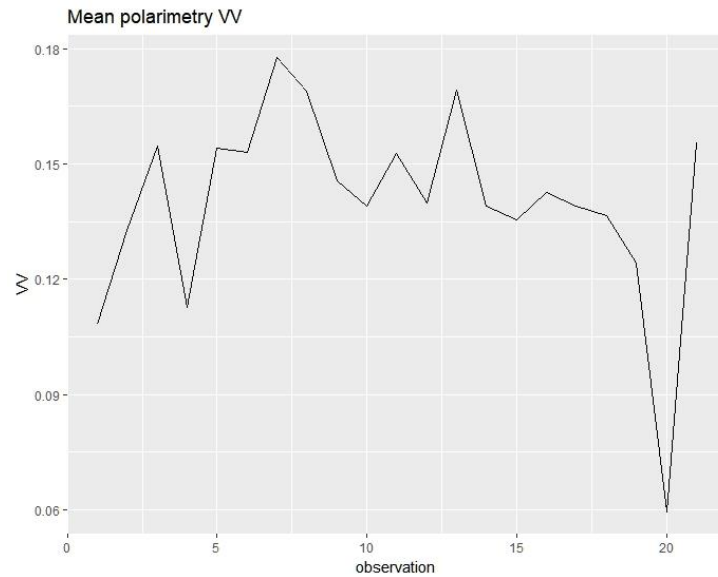
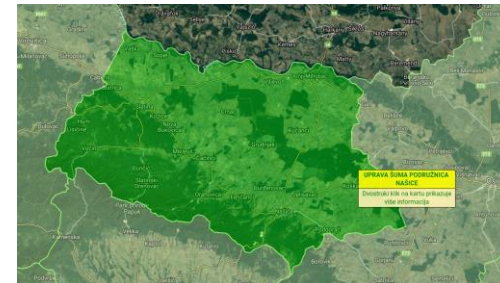
## Forest managerial unit (3000 ha)



## Forest office (10 000 ha)



## Forest administration (50 000 ha)

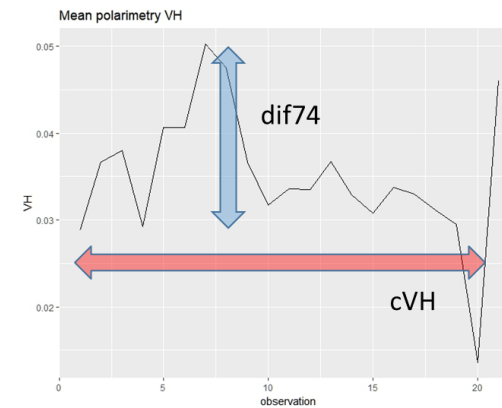
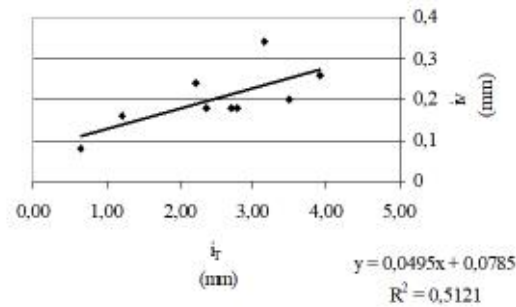
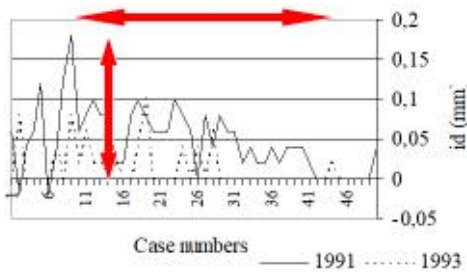
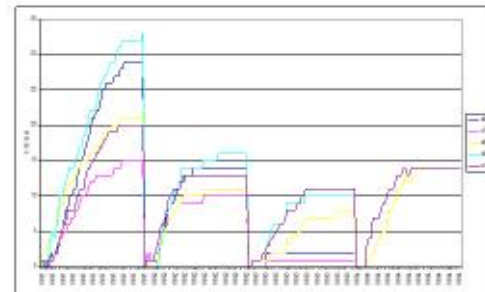




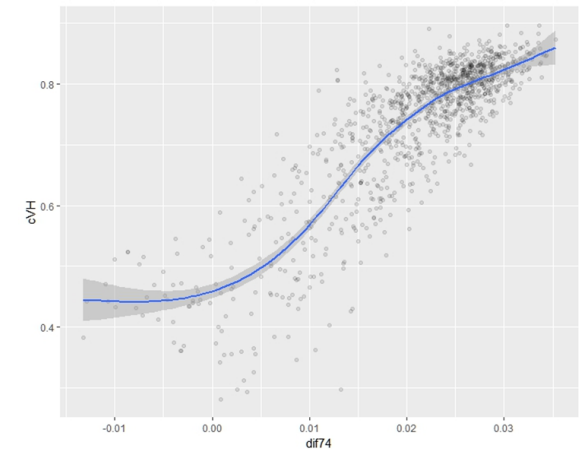
# THE EFFECT OF GROUNDWATER DECREASE ON SHORT AND LONG TERM VARIATIONS OF RADIAL GROWTH AND DIEBACK OF MATURE PEDUNCULATE OAK (*QUERCUS ROBUR* L.) STAND

IVAN PILAŠ<sup>1</sup>, NIKOLA LUKIĆ<sup>2</sup>, BORIS VRBEK<sup>1</sup>, TOMISLAV DUBRAVAC<sup>1</sup>, VALENTIN ROTH<sup>1</sup>,

<sup>1</sup> Department of Ecology and Silviculture, Forest Research Institute, Cvjetno naselje 41, 10450 Jastrebarsko, Croatia; e-mail: ivanp@sumins.hr



dif74 <- VH7 (27.3.) – VH4 (7.2.)  
cVH <- sum (22 VH layers in 2015)



Call:  
lm(formula = cVH ~ dif74)  
Residual standard error: 0.06092 on 1142 degrees of freedom  
Multiple R-squared: 0.7345, Adjusted R-squared: 0.7343  
F-statistic: 3159 on 1 and 1142 DF, p-value: < 2.2e-16