Earth Observation & Machine Learning

for estimating the IRRIGATION potential of municipalities in Vojvodina, Serbia

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WAGENINGEN UNIVERSITY & RESEARCH

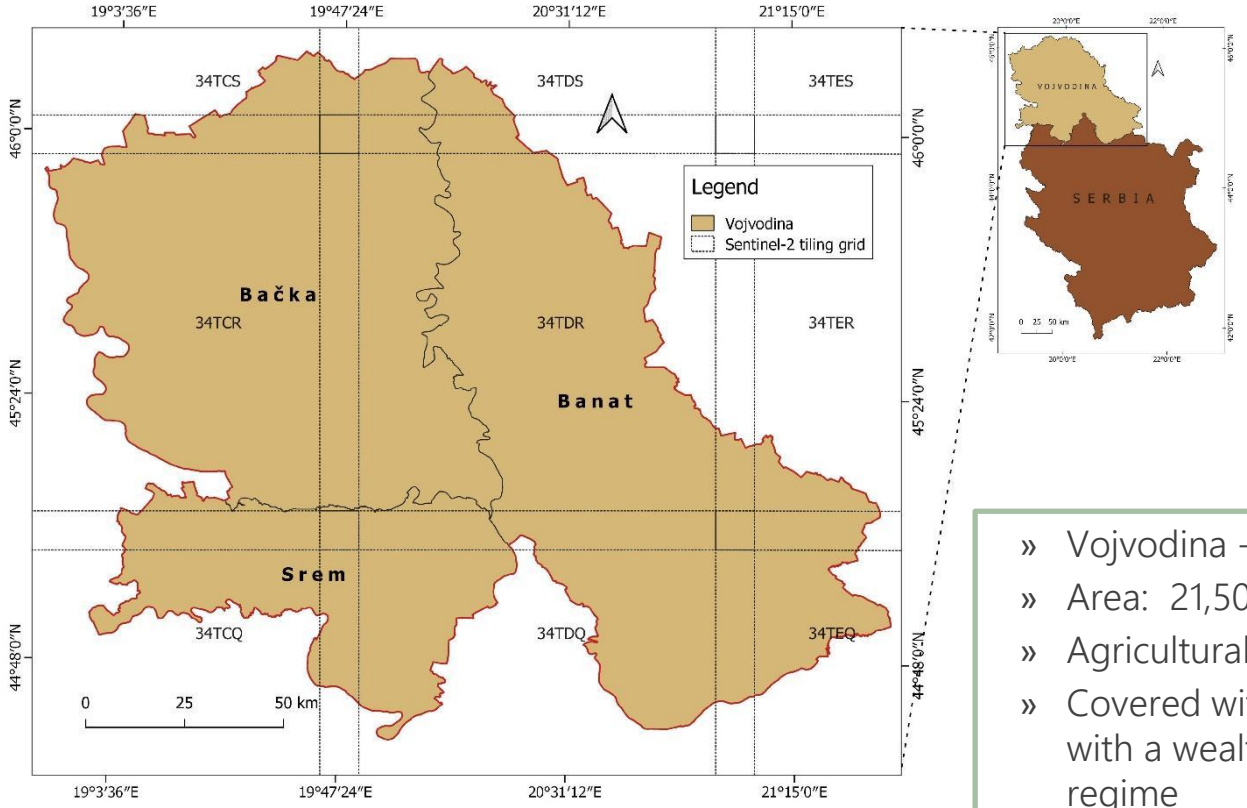
Introduction

- High pressure on agriculture productivity due to climate change and rapid population growth
- Providing enough food is the main challenge in 21st century
- Most frequent serious hazards – drought most severe for agriculture production
- Irrigation as a key for meeting world's food need

- Agriculture is very important in Serbia’s economy
- Knowing exact information about the spatial distribution of irrigated croplands

aims

1. Classifying irrigated and rainfed crops at plot scale
2. Quantified irrigation potential from the canal network



STUDY area

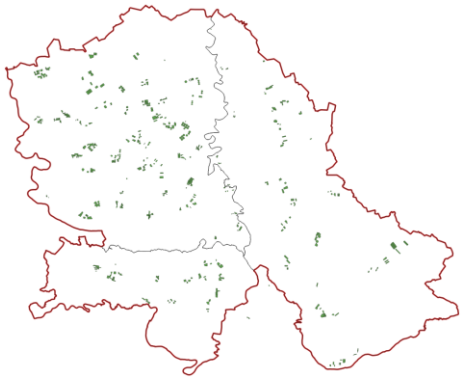
- Vojvodina - main agricultural area in Serbia
- Area: 21,506 km^2
- Agricultural area - 84% of the theritory
- Covered with Chernozem and Eutric Cambisol, with a wealth of water and a regulated water regime

data

» Three crops of interest: maize, soybean, and sugar beet
» 3 years: 2020, 2021, and 2022
» 3 data sets: ground truth data, satellite data and crop classification data

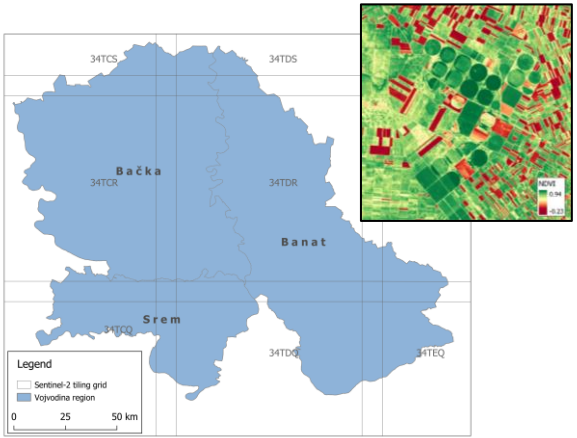
1. Ground truth data

- field campaign (May-Jun)



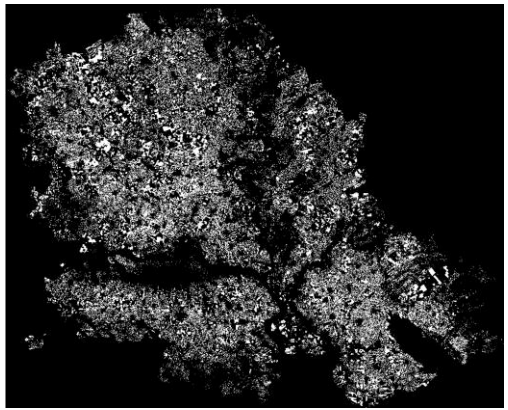
2. Satellite data

- Sentinel 2
- 11 vegetation indices



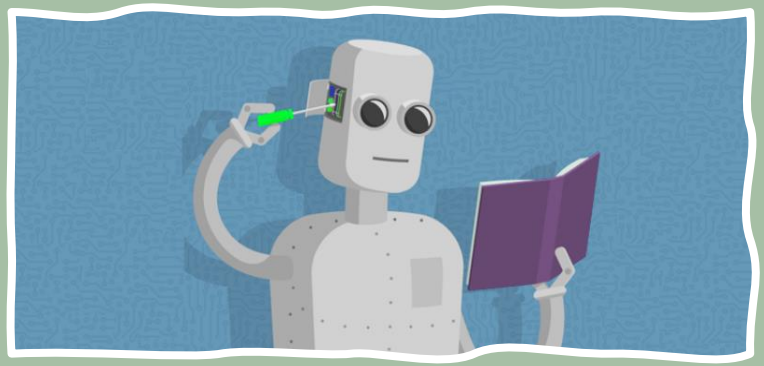
3. Crop classification maps -

- Crop mask creation



Methods

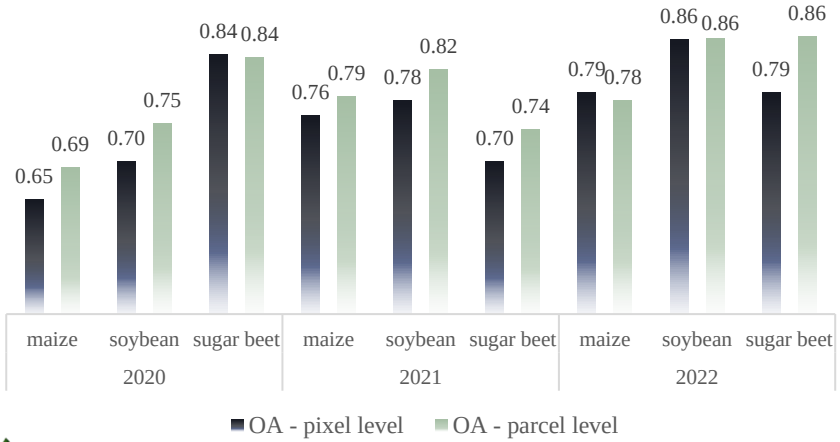
- Machine learning - Random Forest algorithm
- Pixel based classification
- 10-fold cross validation
- Separate model training for each crop type

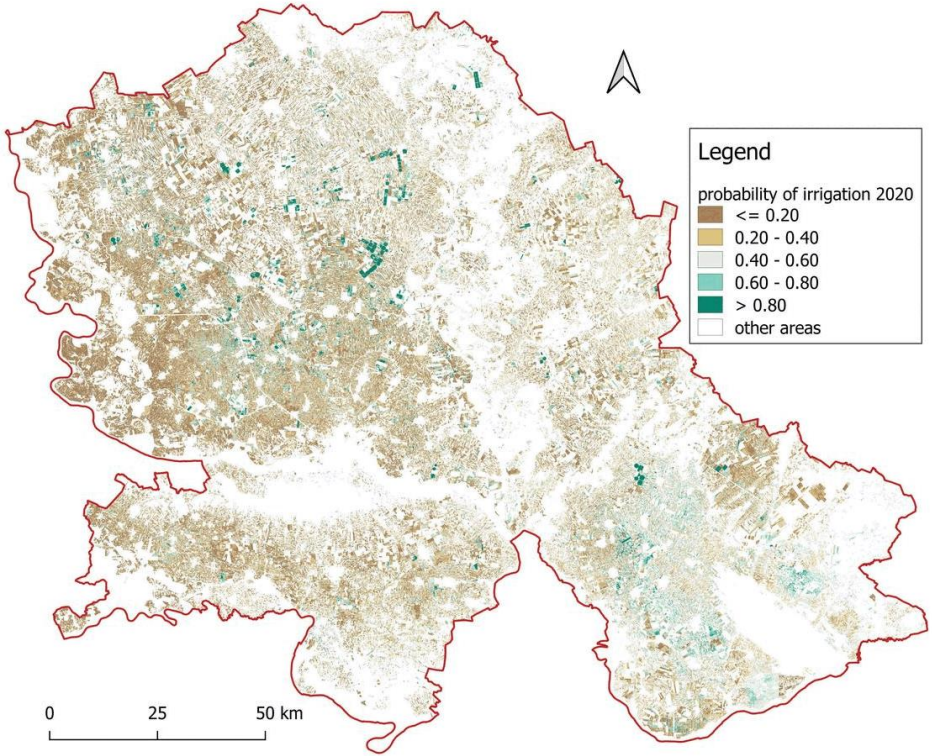


- trained RF classifiers were applied to the entire territory of the Vojvodina region

results

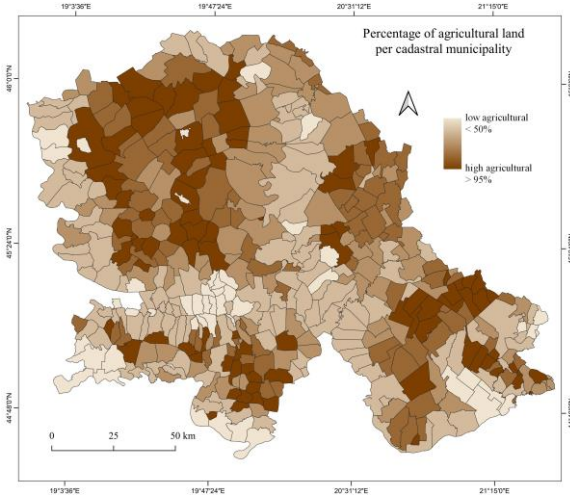
- From the total agricultural area, we detected irrigation on:
  - 1.30% in 2020
  - 1.98% in 2021
  - 3.35% in 2022





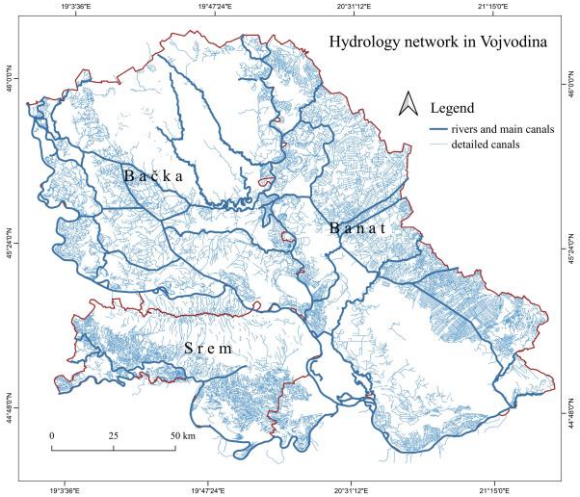
results

agriculture



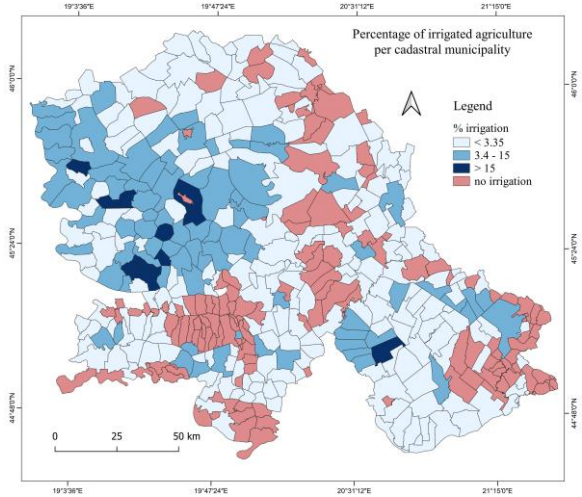
» 1.600.000 ha of arable land - 84% of the Vojvodina territory

Hydrology



» High potential for irrigation from HS DTD – possible to irrigate 936,000 ha

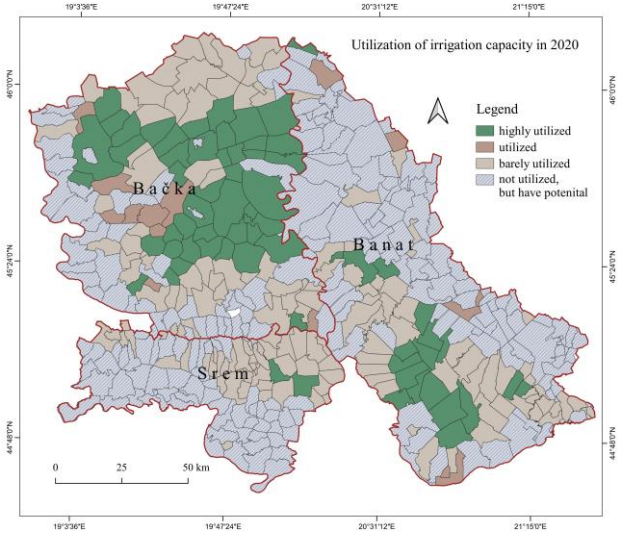
irrigation

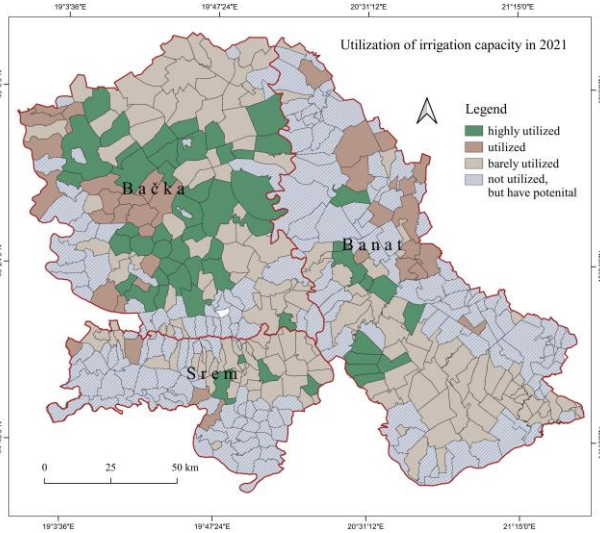


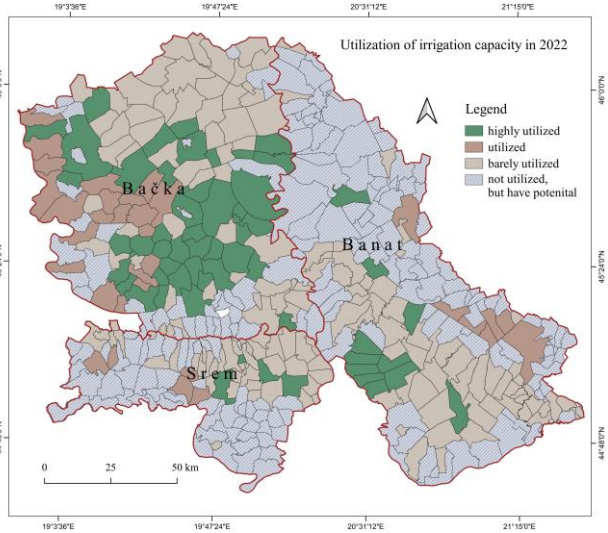
» In the last year only 3.35% of the arable land was irrigated

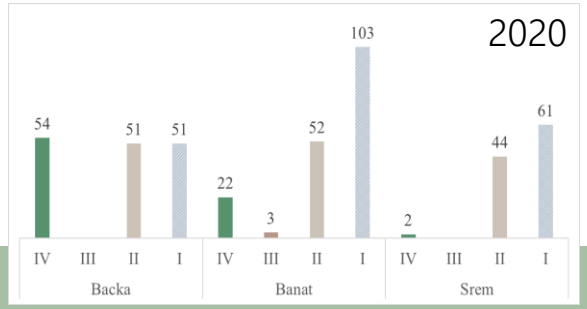
Utilization of irrigation capacity

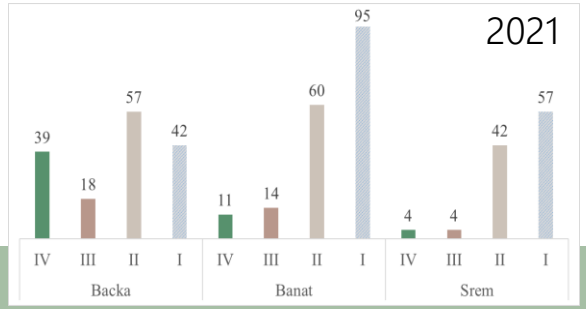
IV) Highly utilized - if „*irrigation > 2020/2021/2022*“ and „*canal dense < 13 m/ha*“
III) Utilized - if „*irrigation > 2020/2021/2022*“ and „*canal dense > 13 m/ha*“
II) Barely utilized - if „*irrigation < 2020/2021/2022*“ and „*canal dense < 13 m/ha*“
I) Not utilized, but have potential - if „*irrigation < 2020/2021/2022*“ and „*canal dense > 13 m/ha*“

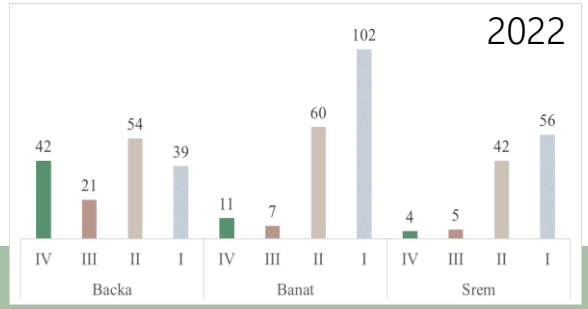




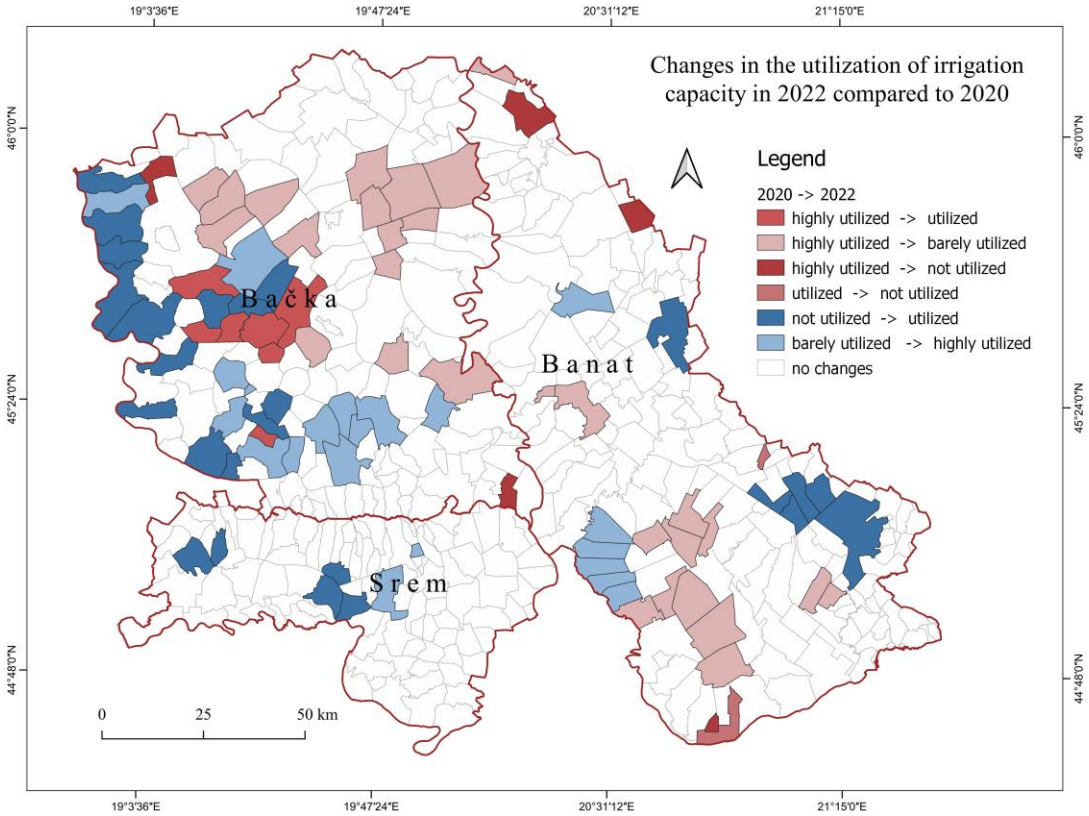




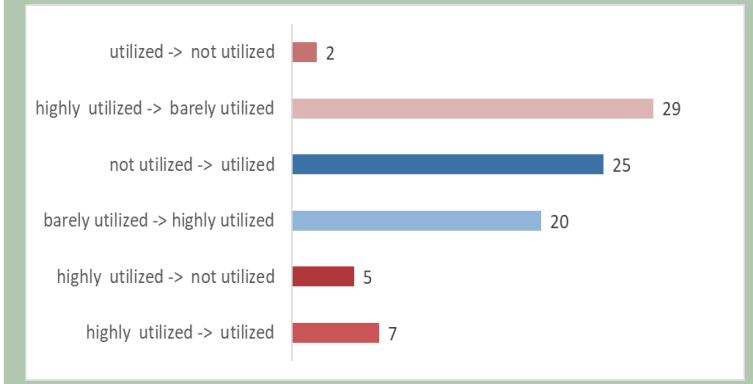




Changes 2020 -> 2022



- 45 municipalities uses more capacity for irrigation in 2022 than in 2020
- In 7 municipalities the systems are not used. Why?



Conclusions & FUTURE *work*

- This method can successfully detect irrigation fields of maize, soybean and sugar beet
- Useful for government and decision-makers when it comes to improve irrigation management
- this research indicates insufficient usage of existing channel infrastructure
- farmers in the Vojvodina region still use irrigation as a supplementary measure during extreme drought conditions

- *Explore what caused differences in irrigation capacity usage (other crop type, unavailability of water, abandoned irrigation systems, and other)*
- *Which municipalities have priority according to climate characteristics, percentage of agricultural land, soil characteristics, and other*

Thank you!

Antares