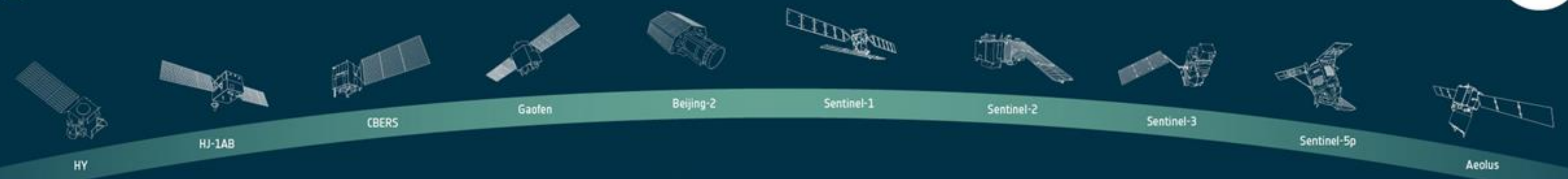


2022 DRAGON 5 SYMPOSIUM

MID-TERM RESULTS REPORTING

17-21 OCTOBER 2022

PROJECT ID.57160

MONITORING WATER PRODUCTIVITY IN CROP PRODUCTION AREAS FROM FOOD SECURITY PERSPECTIVES

DAY 1 & 17. 10. 2022

ID. 57160

PROJECT TITLE: Monitoring water productivity in crop production areas from food security perspectives

PRINCIPAL INVESTIGATORS:

- **Dr. Qinghan Dong, Flemish institute for technological research (VITO), Belgium**
- **Dr. Liang Zhu, Institute of remote sensing and digital earth, Chinese academy of sciences, China**

CO-AUTHORS: Ilina Kamenova, Petar Dimitrov, Milen Chanev, Luchezar Filchev, Qinghan Dong, Liang Zhu

PRESENTED BY: Ilina Kamenova

Dragon 5 Mid-term Reporting

- Project's objectives
- Satellite data: Copernicus Sentinels, ESA, Chinese and ESA Third Party Mission data utilised after 2 years
- In-situ data measurements and requirements
- Field data collection campaigns and periods in P.R. China or other study areas
- Results after 2 years of activity
- Project's schedule, planning & contribution of the partners for the following year
- Level and training of young scientists on the project achievements, including plans for academic exchanges

Project's objectives

- Assess both the agricultural output and the water consumption for crop growth using satellite information and compute subsequently the water productivity

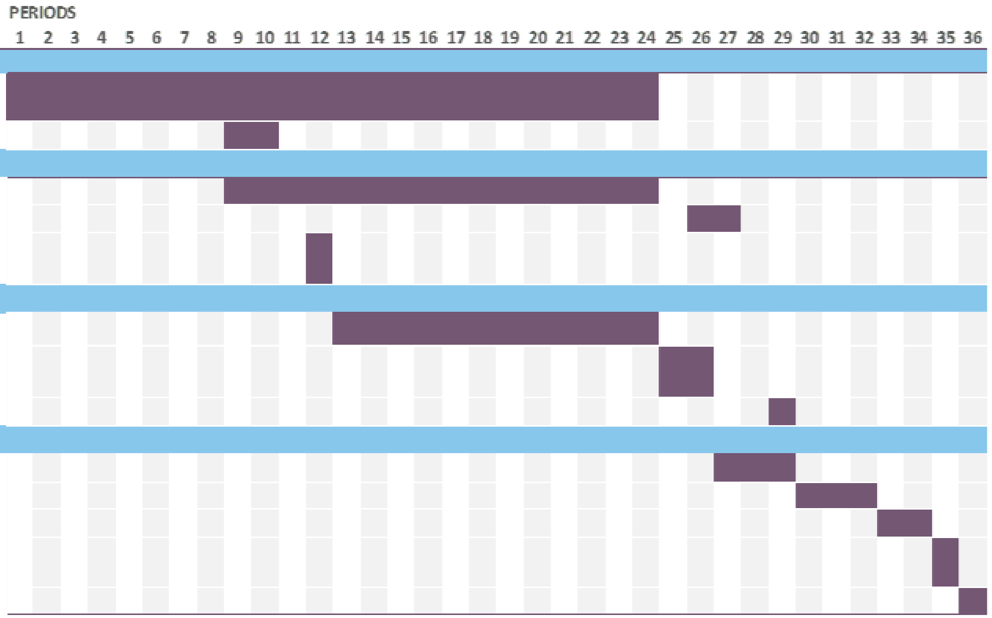
- The outcome of the research could be used as a scientific evidence for water use policy making by considering the environmental impact while meeting food security imperatives

Monitoring water productivity in crop production areas from food security perspectives

Select a period to highlight at right. A legend describing the charting follows.

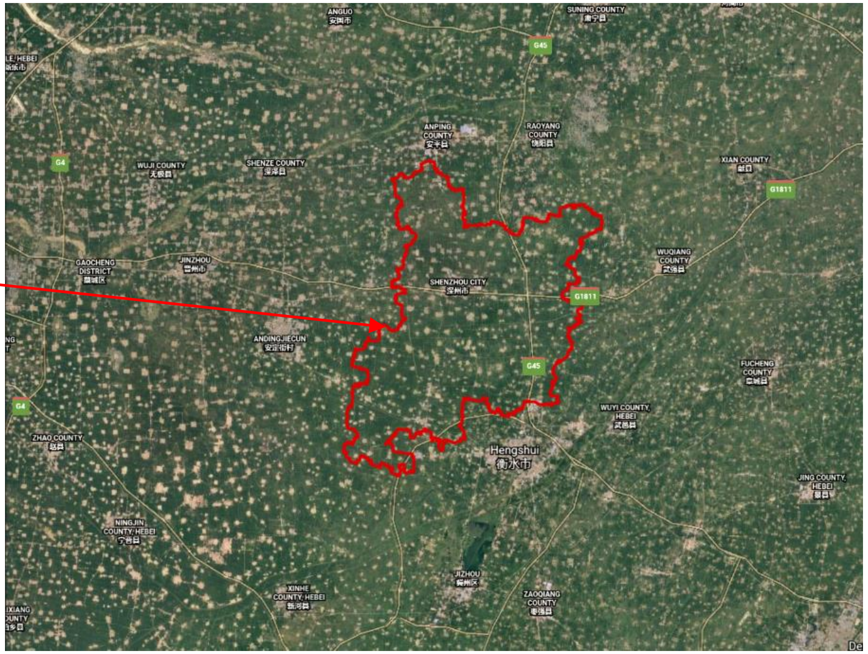
Period Highlight: Plan Duration | Actual Start | % Complete | Actual (beyond plan) | % Complete (beyond plan)

	ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
WP100	Field data collection					
	Field data collection and pre-processing of remote sensing and meteorological data - Season 1 + Season 2	1	24	1	24	100%
	TerraScope Training	9	2	9	2	100%
WP200	Crop type identification					
	Crop type mapping for the study regions - Season 1 + 2	9	16	9	16	100%
	Validation or comparison with the local official statistics - Season 1+2	26	2	26	2	100%
MS1	Milestone 1 (MS1) – 1 ESA Dragon 5 Conference report	12	1	12	1	100%
WP300	Crop Yield forecasting					
	Crop yield modeling for the study regions - Season 1 + 2	13	12	13	12	100%
	Validation or comparison with the local official statistics - Season 1 + 2	25	2	25	2	100%
MS1	Milestone 2 (MS2) – 1 conference report / 1 peer-reviewed Journal article	29	1	29	1	100%
WP400	Evapotranspiration and water productivity mapping (WPM)					
	Maps of actual ET per targeted crop – Season 1+2	27	3	27	3	100%
	Water productivity maps for each study region and for each crop - Season 1+2	30	3	30	3	100%
	Validation or comparison with the local official statistics - Season 1+2	33	2	33	2	100%
MS3	Milestone 3 (MS3) – 1 ESA Dragon 5 Conference report / 1 peer-reviewed Journal article	35	1	35	1	100%
FR	Final Report	36	1	36	1	100%



Study Area in China

- Shenzhou, the study area in China is a county-level city in Hebei province on the North China Plain (NCP), with wheat and corn as main agricultural species.



Study areas

Study Area in Europe

- Parvomay Municipality, the study area in Bulgaria, is located in the Upper Thracian Lowland, in the southern part of the country. The area is dominated by winter wheat, maize and sunflower but many other crops such as rice or vegetables, making the agricultural landscape diverse. The production much depends on irrigation infrastructures which are poorly maintained. The area is characterized by medium to high baseline water stress which affects farming.

EO Data Delivery

ESA Third Party Missions	No. Scenes
1. 1.GeoEye-1/WorldView2	2
2.	
3.	
4.	
5.	
6.	
Total:	2
Issues:	

ESA, Explorers & Sentinels data	No. Scenes
1. Sentinel 2	16
2.	
3.	
4.	
5.	
6.	
Total:	16
Issues:	

Chinese EO data	No. Scenes
1. GF-1, GF-2	4
2.	
3.	
4.	
5.	
6.	
Total:	4
Issues:	

Project Results– WP1

In situ measurements in study area in Europe

- Phenological observations
- Biomass: dry and fresh biomass
- Crops biometrics: height, density
- Crop yield

Phenophase Tillering

Phenophase Stem elongation

Phenophase Milk stage

Project Results– WP1

In situ measurements in study area in Europe

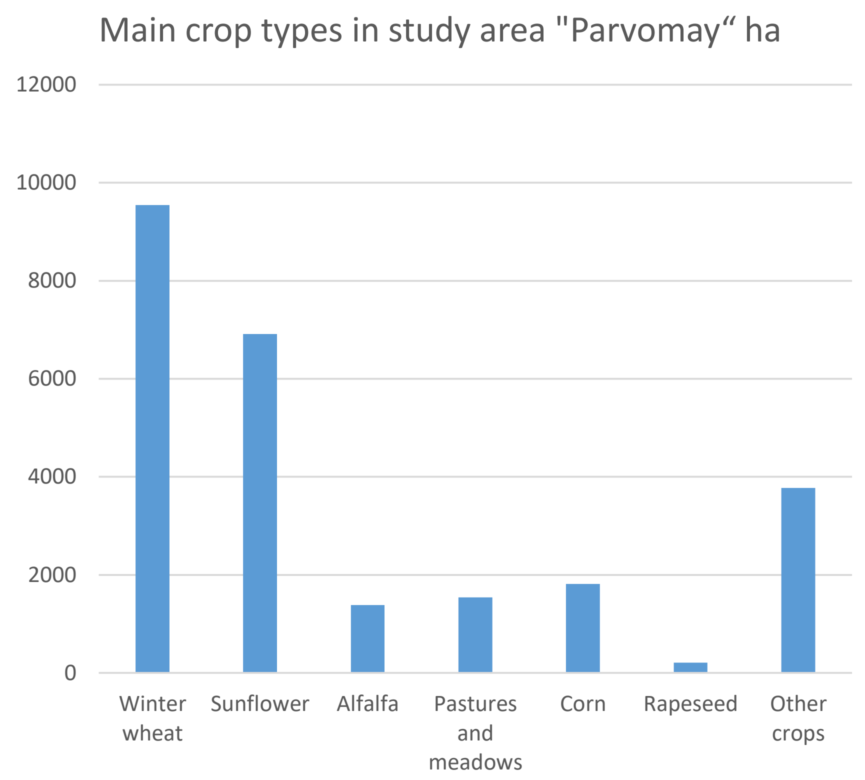
- Meteorological data: temperature, rainfall, radiation
- UAV image (WingtraOne, equipped with MicaSense RedEdge-MX и RGB camera Canon)

Project Results– WP2

Crop type identification:

Three classification scenarios are performed during vegetation season 2021.

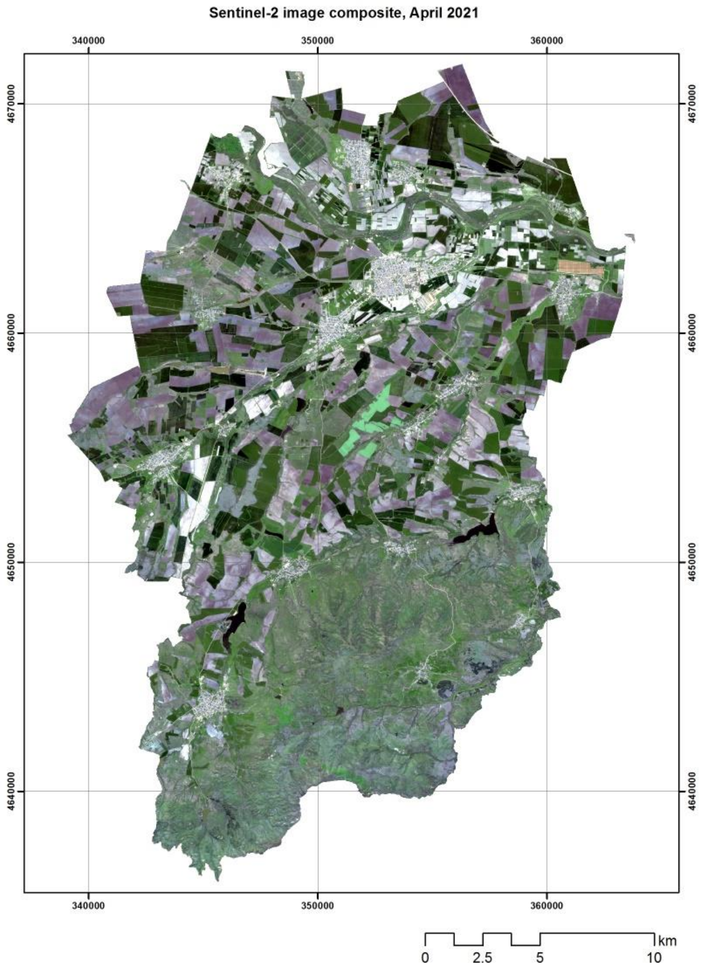
- Scenario 1 includes 5 classes: winter wheat, winter rapeseed, alfalfa, Pastures and meadows, other crops. Classification is produced using S2 image composite for April 2021
- Scenario 2 includes 5 classes: sunflower, maize, alfalfa, Pastures and meadows, other crops. Classification is produced using S2 image composite for June 2021
- Scenario 3 includes 7 classes: winter wheat, winter rapeseed, sunflower, maize, alfalfa, pastures and meadows, other crops. Classification is produced using S2 image stack of April and June 2021 composites

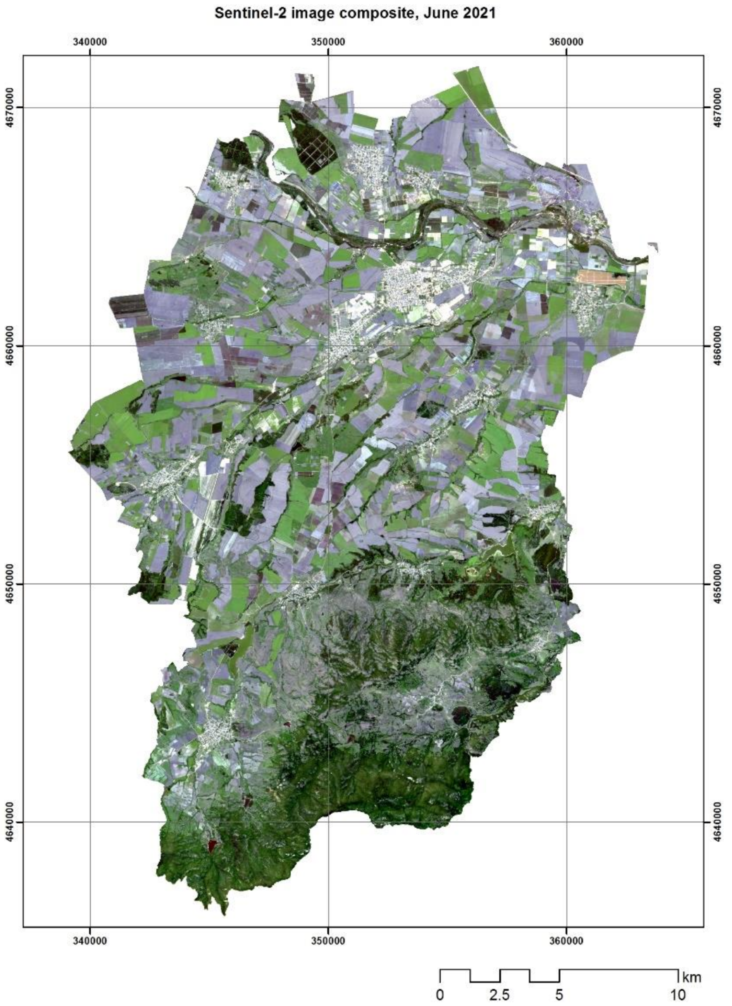


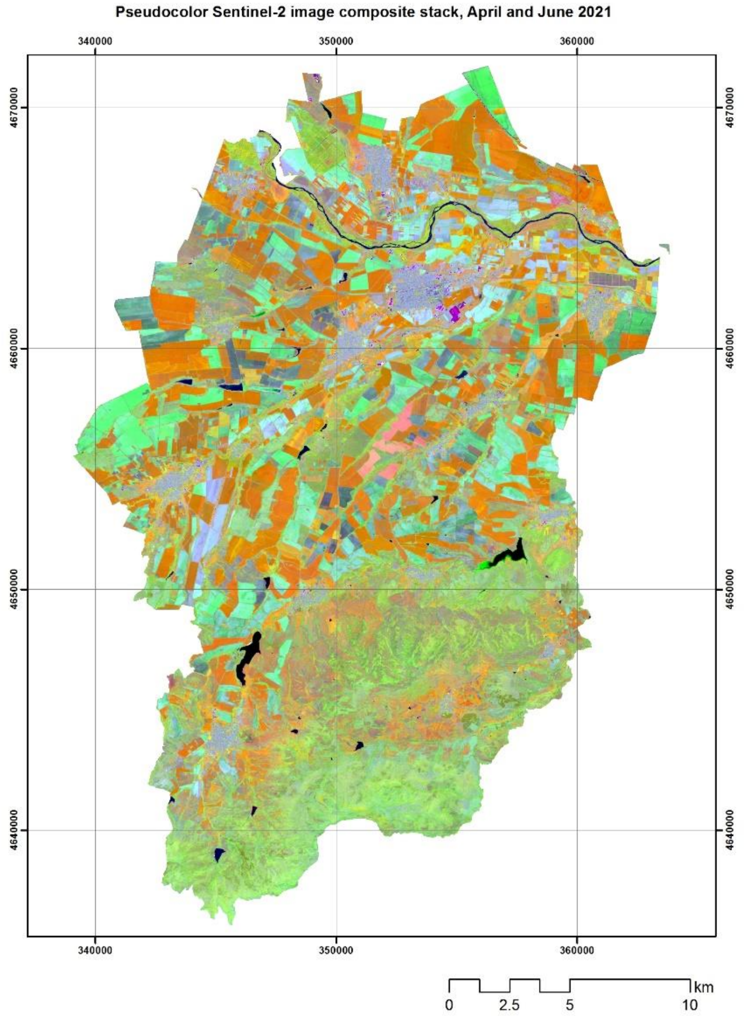
Project Results– WP2

- Sentinel-2 image composites

- image composites are created in Google Earth Engine, taking the median value for the investigated month. All bands with spatial resolution of 10 and 20 m are included in the composites. The 20 m bands are resampled to 10 meter bands.



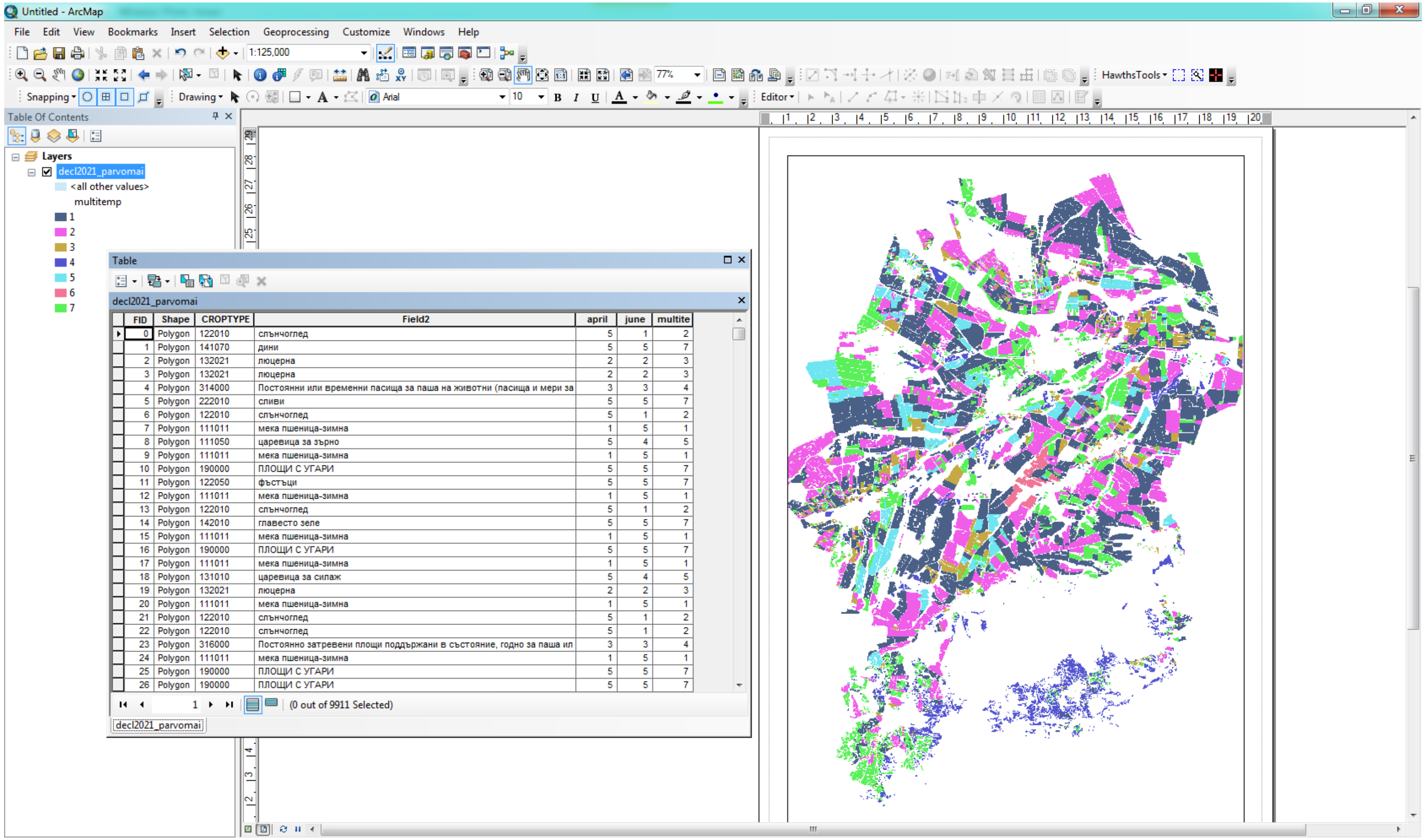




Project Results– WP2

- Reference data used for training and validation

- LPIS dataset, split into 2 datasets (50% training and 50% validation dataset)



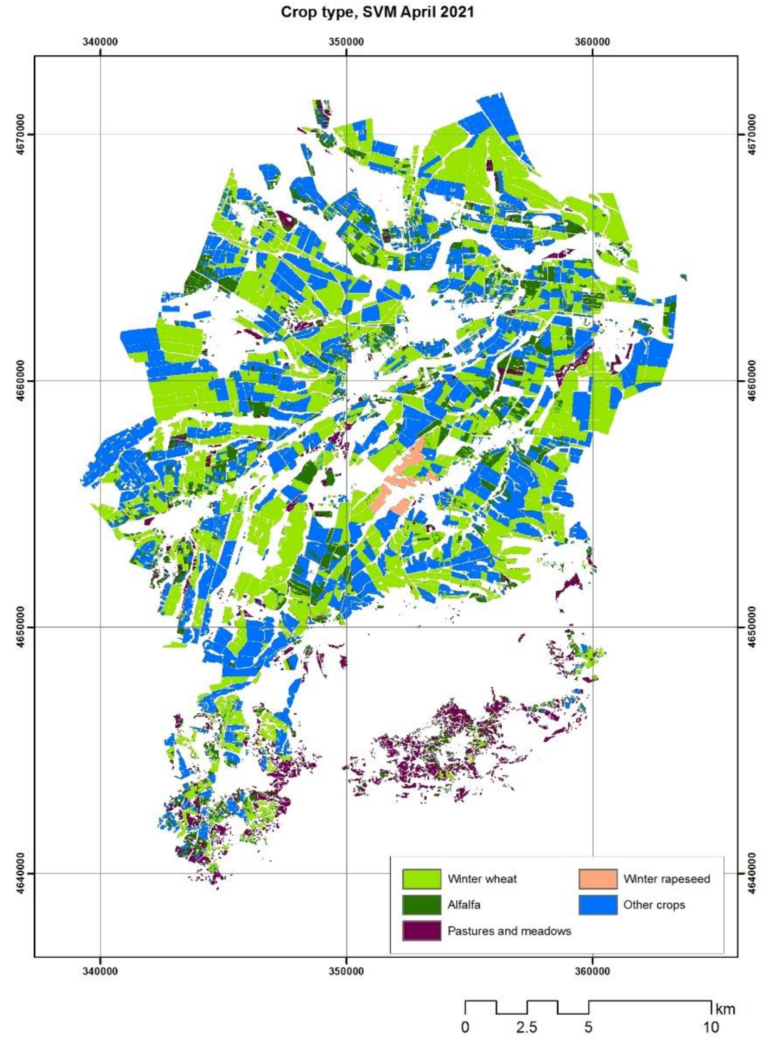
FID	Shape	CROPTYPE	Field2	april	june	multite
0	Polygon	122010	слънчоглед	5	1	2
1	Polygon	141070	дини	5	5	7
2	Polygon	132021	люцерна	2	2	3
3	Polygon	132021	люцерна	2	2	3
4	Polygon	314000	Постоянни или временни пасища за паша на животни (пасища и мери за	3	3	4
5	Polygon	222010	сливи	5	5	7
6	Polygon	122010	слънчоглед	5	1	2
7	Polygon	111011	мека пшеница-зимна	1	5	1
8	Polygon	111050	царевица за зърно	5	4	5
9	Polygon	111011	мека пшеница-зимна	1	5	1
10	Polygon	190000	ПЛОЩИ С УГАРИ	5	5	7
11	Polygon	122050	фъстъци	5	5	7
12	Polygon	111011	мека пшеница-зимна	1	5	1
13	Polygon	122010	слънчоглед	5	1	2
14	Polygon	142010	главесто зеле	5	5	7
15	Polygon	111011	мека пшеница-зимна	1	5	1
16	Polygon	190000	ПЛОЩИ С УГАРИ	5	5	7
17	Polygon	111011	мека пшеница-зимна	1	5	1
18	Polygon	131010	царевица за силаж	5	4	5
19	Polygon	132021	люцерна	2	2	3
20	Polygon	111011	мека пшеница-зимна	1	5	1
21	Polygon	122010	слънчоглед	5	1	2
22	Polygon	122010	слънчоглед	5	1	2
23	Polygon	316000	Постоянно затревени площи поддържани в състояние, годно за паша ил	3	3	4
24	Polygon	111011	мека пшеница-зимна	1	5	1
25	Polygon	190000	ПЛОЩИ С УГАРИ	5	5	7
26	Polygon	190000	ПЛОЩИ С УГАРИ	5	5	7

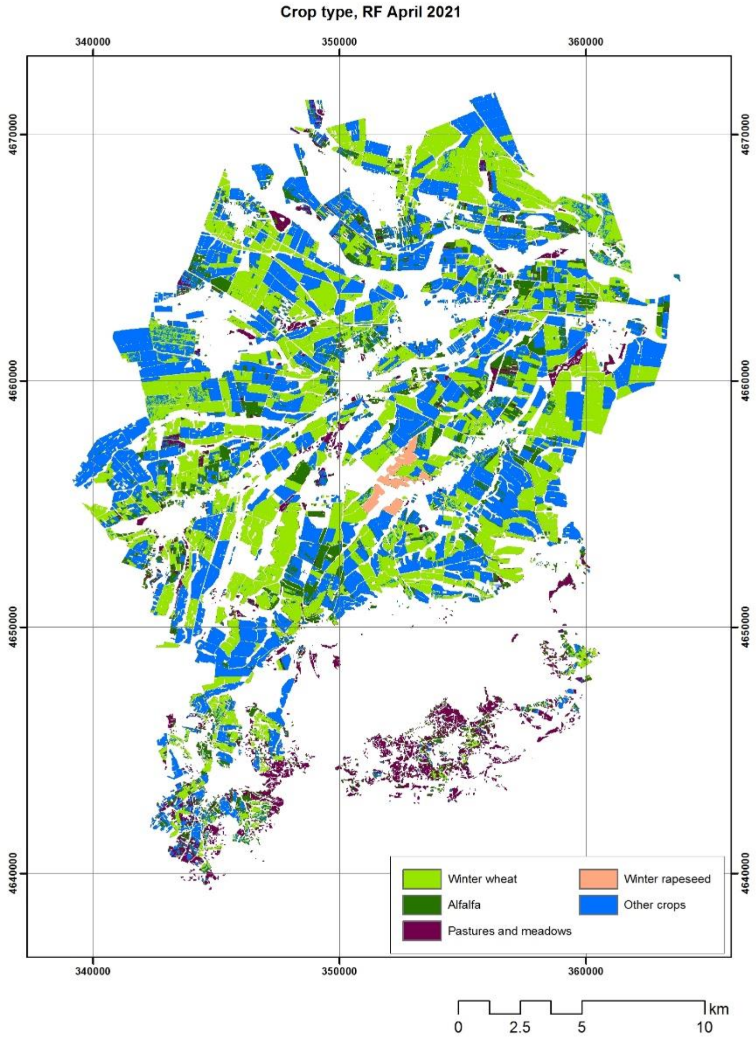
(0 out of 9911 Selected)

decl2021_parvomai

Project Results– WP2

- Scenario 1



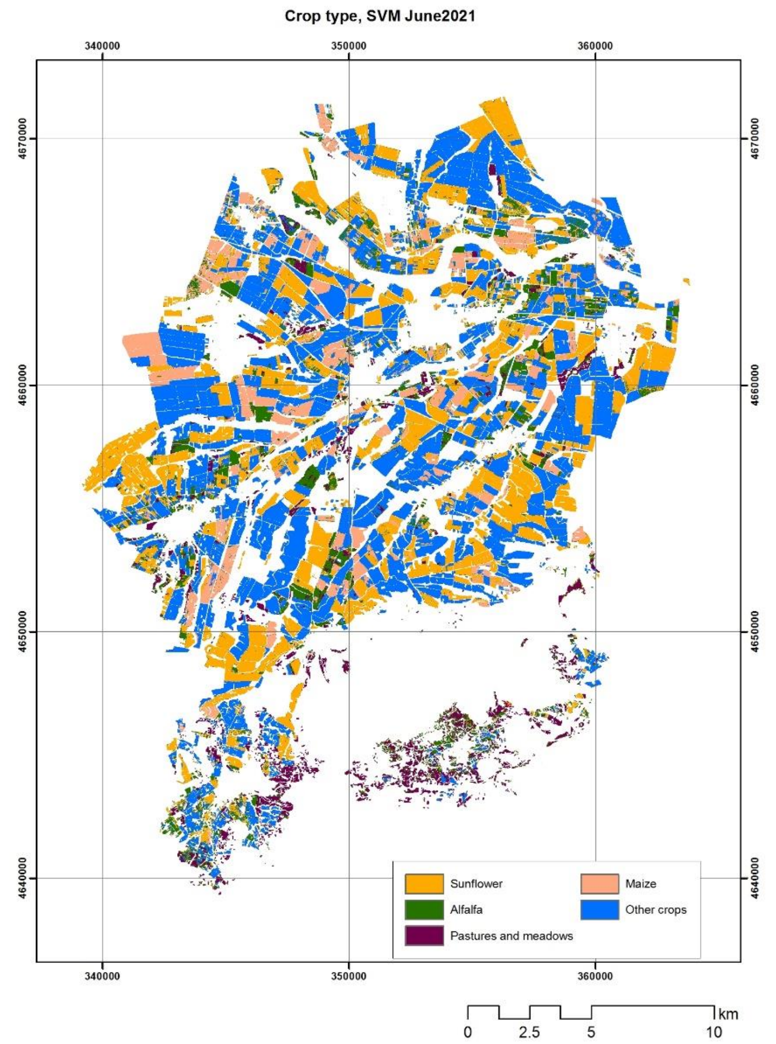


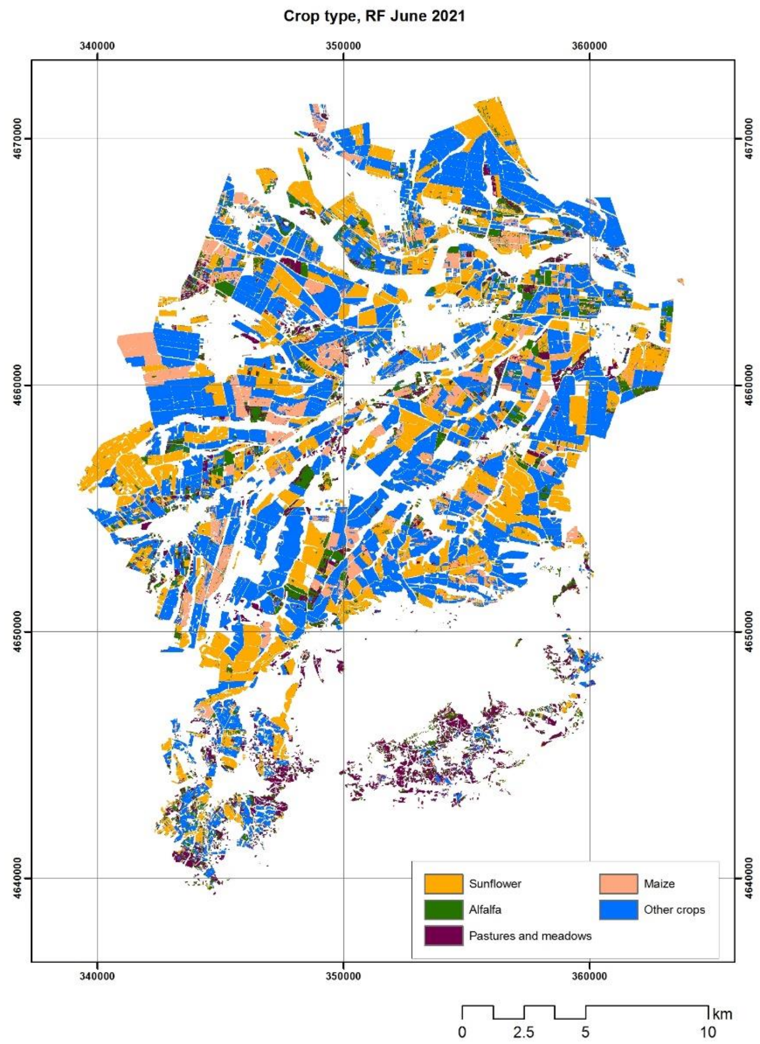
	SVM	RF
Overall Accuracy	82.41	82.13

	F1 Accuracy SVM	F1 Accuracy RF
Winter wheat	91.38	90.4
Alfalfa	44.7	43.97
Pastures and meadows	74.28	70.16
Winter rapeseed	98.3	98.25
Other crops	83.18	84.4

Project Results– WP2

- Scenario 2



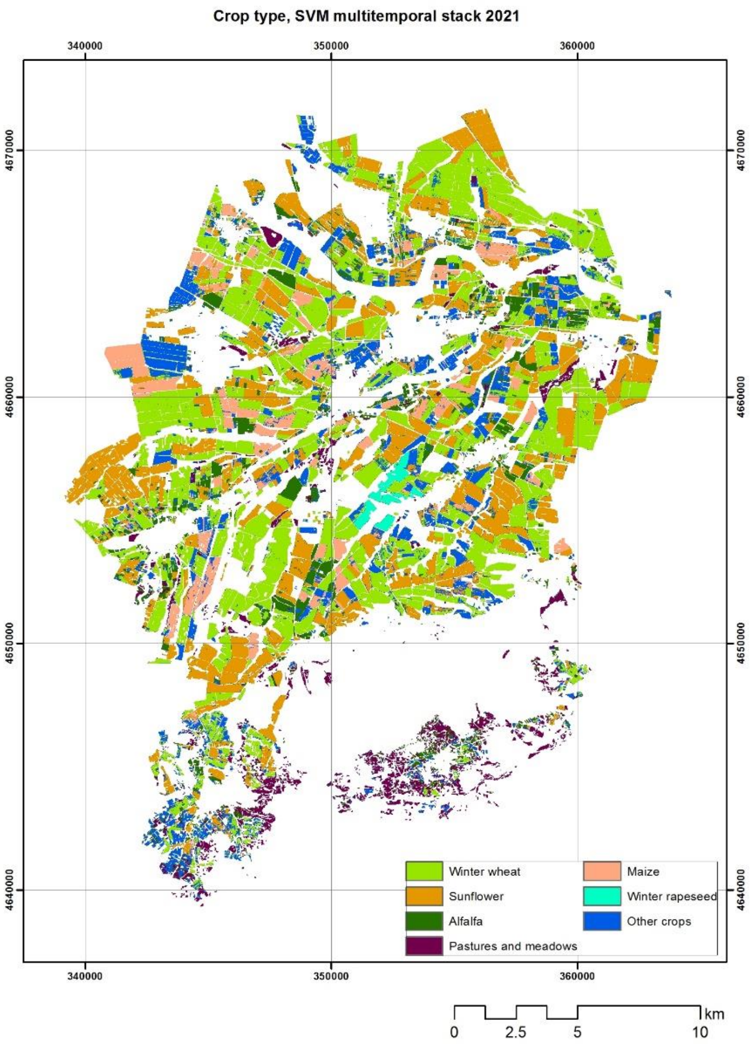


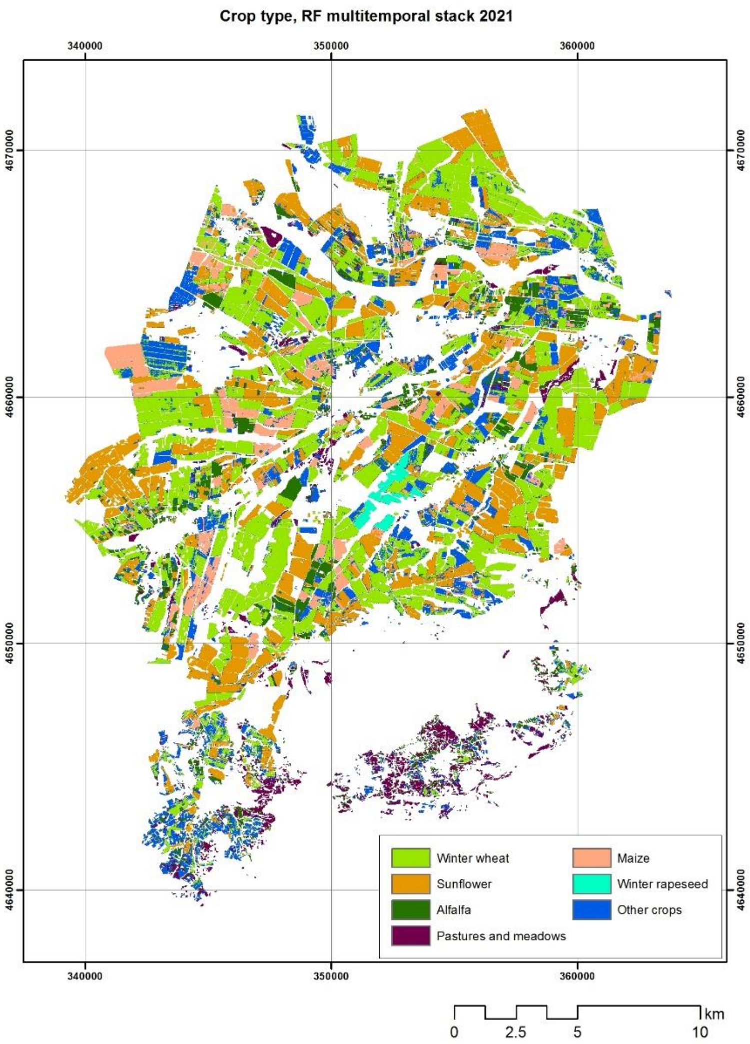
	SVM	RF
Overall Accuracy	82.65	80.28

	F1 Accuracy SVM	F1 Accuracy RF
Sunflower	88.73	87.95
Alfalfa	54.46	48.4
Pastures and meadows	68.57	54.39
Maize	70.35	64.87
Other crops	88.61	88.48

Project Results– WP2

- Scenario 3





	SVM	RF
Overall Accuracy	86.08	82.52

	F1 Accuracy SVM	F1 Accuracy RF
Winter wheat	92.75	91.13
Sunflower	92.33	90.8
Alfalfa	63.62	56.59
Pastures and meadows	78.11	68.73
Maize	87.47	81.64
Winter rapeseed	97.93	98.35
Other crops	68.45	63.09

Project Results– WP2

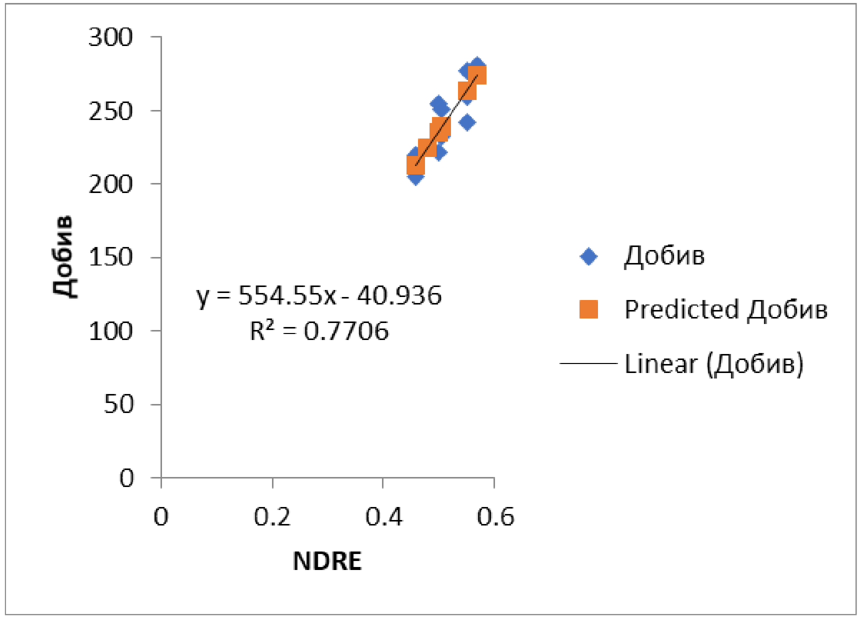
- Main conclusions

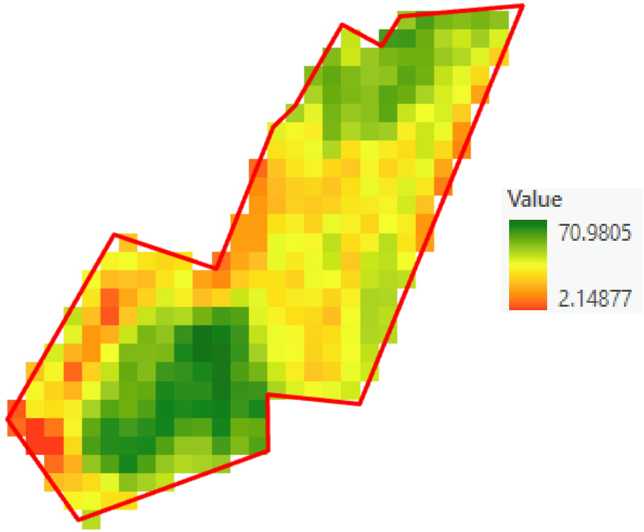
- Winter wheat and winter rapeseed could be distinguished and classified with high accuracy in April composite
- Sunflower and maize could be classified with good accuracy in June, and accuracy rises with addition of information from April
- Alfalfa and pastures are difficult to distinguish in any composite, but the accuracy rises with adding combining composites

Project Results– WP3

Crop yield modelling:

- Set of vegetation indices are calculated based on Sentinel-2 bands, for the test fields fields
- Regression models are calculated using crop yield data, and vegetation indices as an independent variable





Crop yield, calculated with NDRE

Planning & contribution of the partners for the following year

- Field campaign will be performed in 2023 for crop yield collection, Parvomay Bulgaria
- The crop water productivity will be produced using the Simplified Surface Energy Balance model (SSEB) in collaboration between SRTI-BAS, VITO and RADI-CAS
- Academic exchange of 2 YS from SRTI-BAS to VITO

European side:

- **Ilina Kamenova** Ph.D. student at Space Research and Technology Institute at the Bulgarian Academy of Science. Her work is focused on: Agricultural crop type identification, Evapotranspiration estimation.

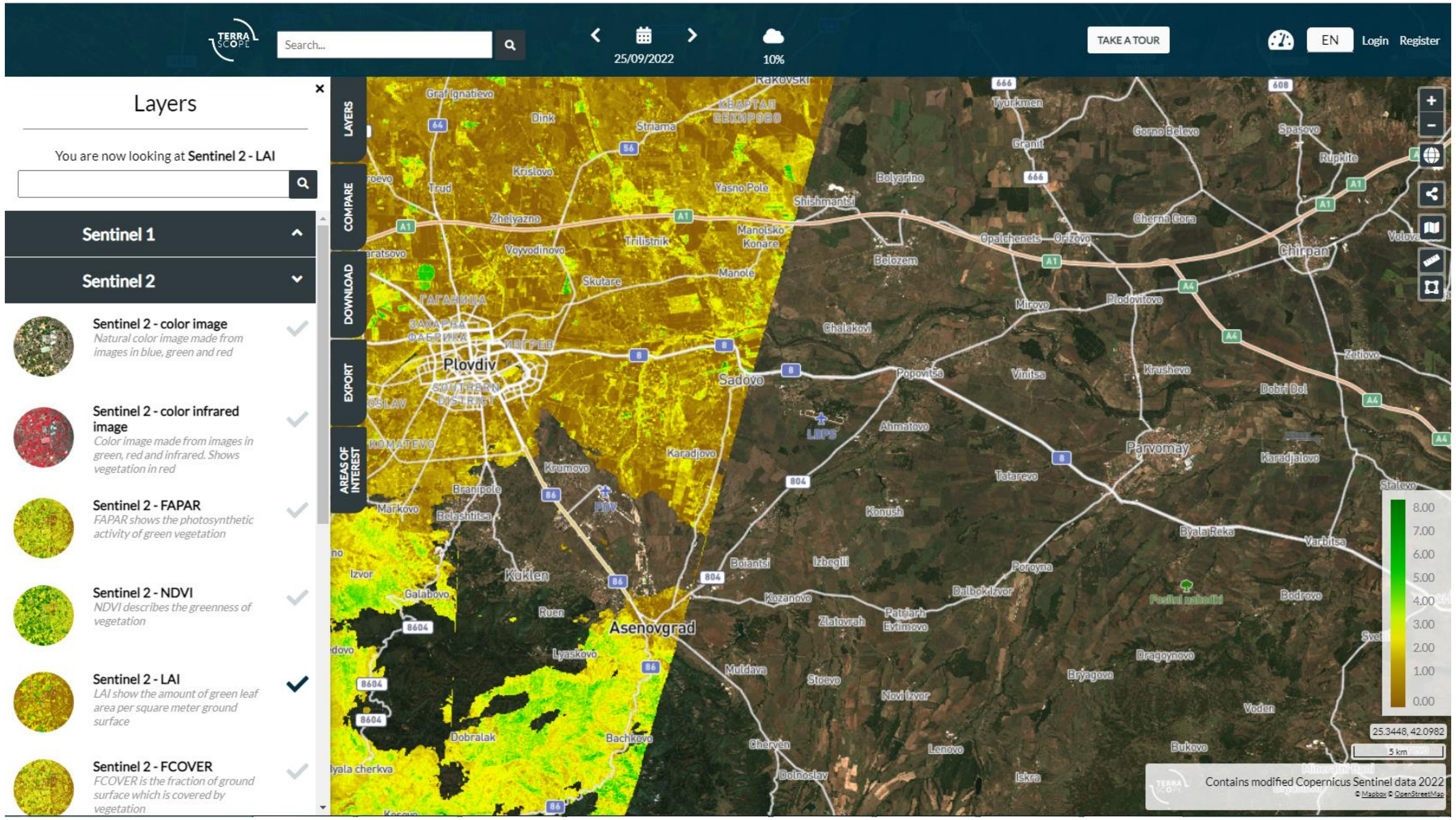
- **Milen Chanev** Ph.D. student at Space Research and Technology Institute at the Bulgarian Academy of Science. His work is focused on: Crop yield prediction, Calculation of Water productivity

European Young scientists contributions in Dragon 5

Name	Institution	Poster title	Contribution
Ilina Kamenova	Space Research and technology Institute- Bulgarian academy of Sciences	Crop type mapping using Sentinel-2 data in Parvomay, Bulgaria (oral presentation)	Image classifications, accuracy assessment
Milen Chanev	Space Research and technology Institute- Bulgarian academy of Sciences	Application of UAV in organically grown einkorn.	Field data collection, UAV data collection, statistical analysis, yield mapping

Young scientists academic exchanges

- Both YS will be trained in VITO to operate with Terra scope engine
- Training will happen in November 2022



Thank you for your attention!

ilina.kamenova@space.bas.bg