



Agricultural monitoring for Ukraine in EU4UA

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Who we are?



National Technical University of Ukraine «Kyiv Polytechnic Institute»

- Department of Mathematical Modelling and Data Analysis

Space Reserch Institute National Academy of Sciences of Ukraine

- Department of space information technologies and systems
- GEO Working Plan - **GEOGLAM, JECAM**
- **EuroGEO**
- **Copernicus Academy**





Our expertise

- Satellite monitoring
- Machine learning on satellite data
- Land cover/land use
- Geospatial intelligence

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Journals & Magazines > IEEE Geoscience and Remote Sensing Letters > Volume: 14 Issue: 5 ?

Deep Learning Classification of Land Cover and Crop Types Using Remote Sensing Data

Publisher: IEEE

Cite This

PDF

Nataliia Kussul ; Mykola Lavreniuk ; Sergii Skakun ; Andrii Shelestov All Authors

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Abstract

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Abstract:

Deep learning (DL) is a powerful state-of-the-art technique for image processing including remote sensing (RS) images. This letter describes a multilevel DL architecture that targets land cover and crop type classification from multitemporal



Big data challenge - cloud computing required

- EO4UA initiative
- NoR ESA Support within EU4UA Initiative

Project Name: “Crop mapping and yield forecasting for Ukraine”

Main goal: The main objective is to use the **IaaS** service provided by the CREODIAS environment to classify crops and predict yields based on satellite and meteorological data available in the EO data repository.

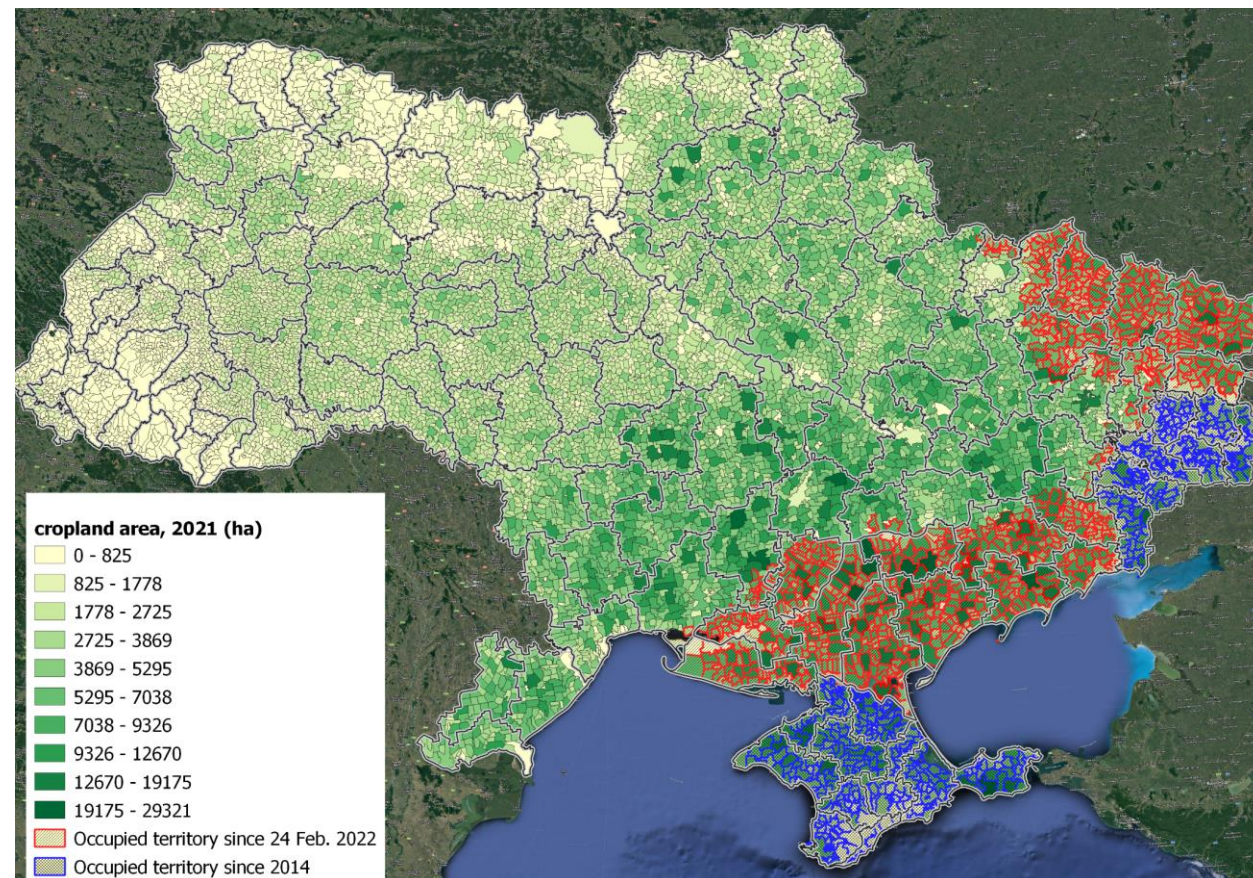
Service Provider: The **CREODIAS IaaS** service provided by the CloudFerro

Occupied cropland 2022



In MLN ha	Occupied since 2014	Occupied since 24 Feb. 2022	Not occupied	Total MLN ha
Cropland	1,73 (5.6%)	5,70 (18.3%)	23,58 (76.1%)	31,00
Winter crops 2022	0,59 (6.6%)	2,05 (22.9%)	6,33 (70.5%)	8,97

Total **occupied** cropland is **5.7 MLN ha**

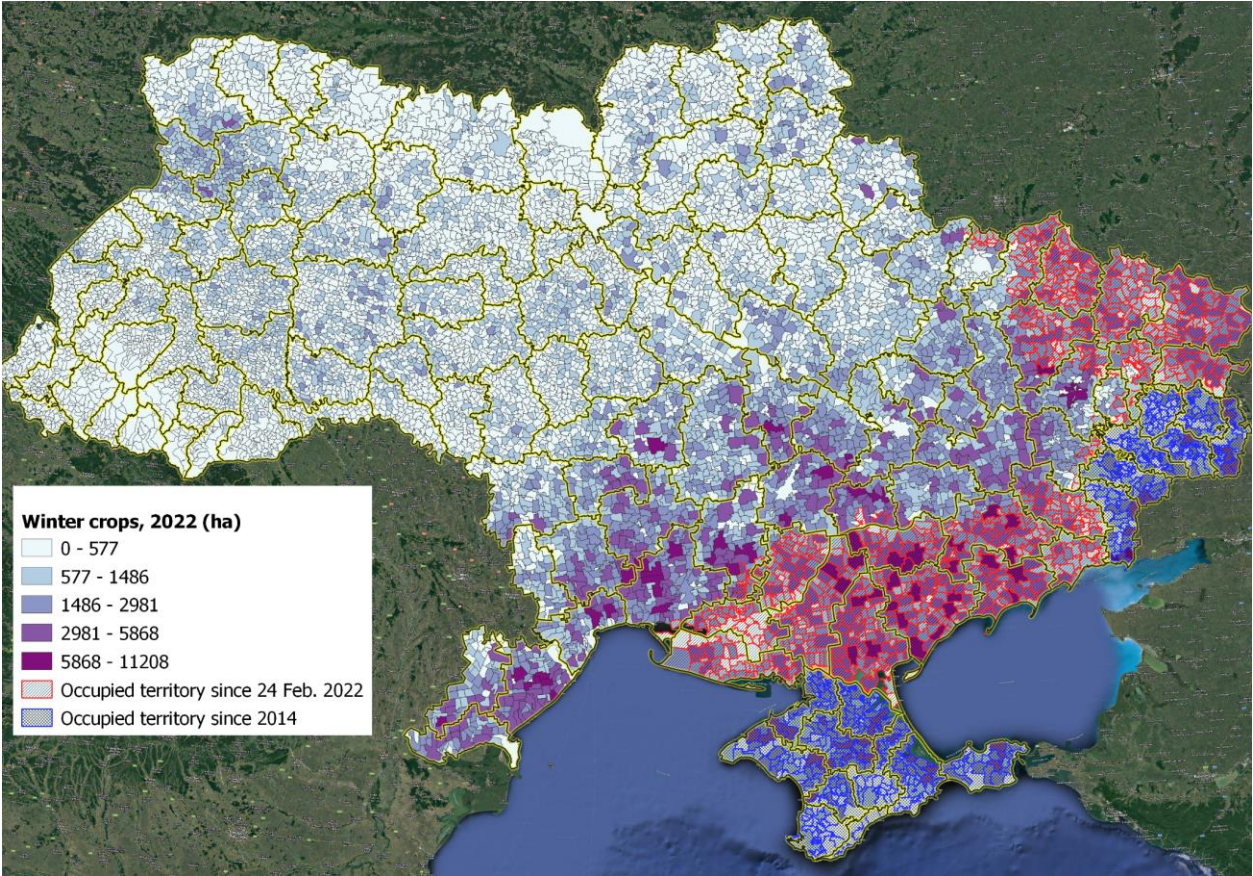




Occupied winter crops 2022

In MLN ha	Occupied since 2014	Occupied since 24 Feb. 2022	Not occupied	Total
Cropland	1,73 (5.6%)	5,70 (18.3%)	23,58 (76.1%)	31,00
Winter crops 2022	0,59 (6.6%)	2,05 (22.9%)	6,33 (70.5%)	8,97

Total **occupied** winter crops is **2.05 MLN ha**

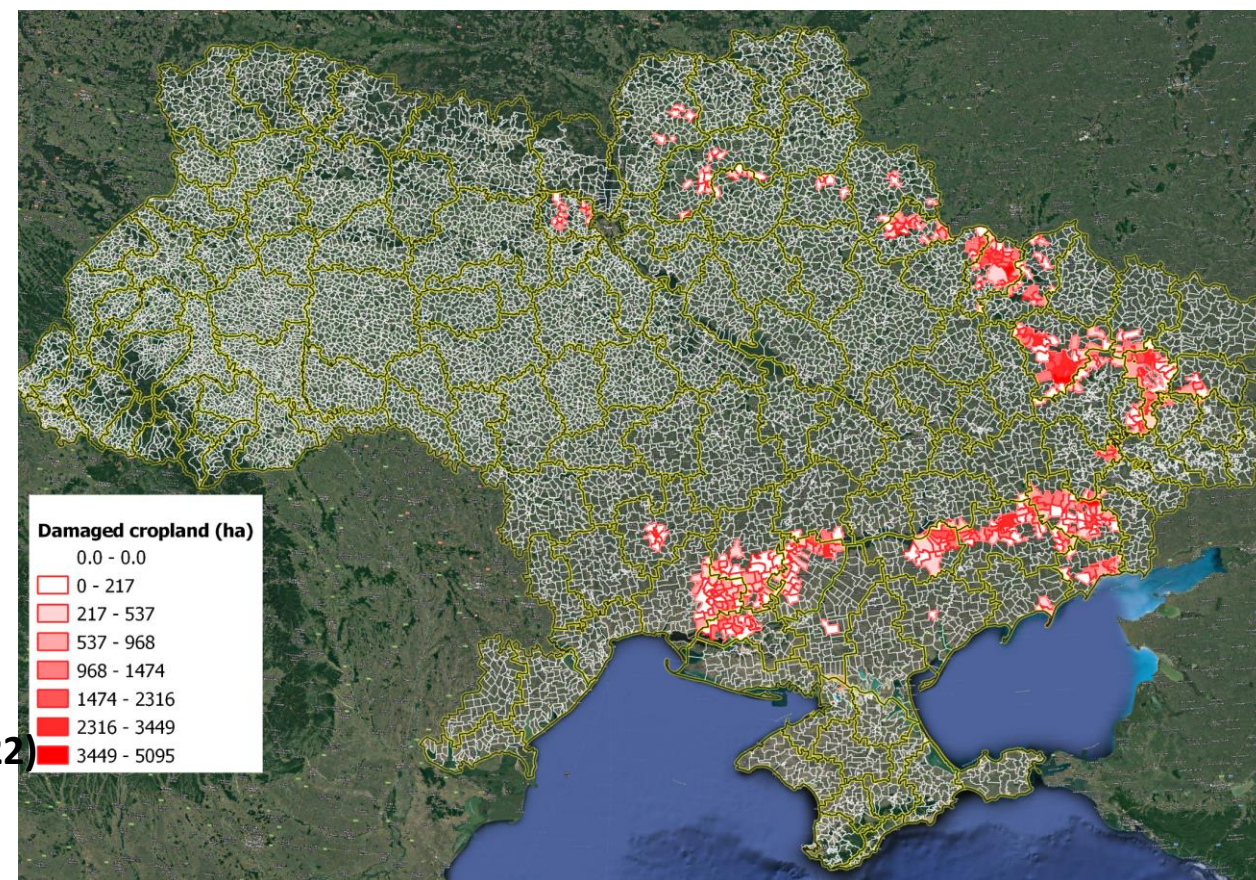




Damaged crops 2022

In MLN ha	Occupied since 2014	Occupied since 24 Feb. 2022	Not occupied	Total
Cropland	1,73 (5.6%)	5,70 (18.3%)	23,58 (76.1%)	31,00
Winter crops 2022	0,59 (6.6%)	2,05 (22.9%)	6,33 (70.5%)	8,97

Direct **damaged** area is **272 th. ha** (as of 11 October 2022)





Damaged fields (examples)

Zaporizka oblast, Vasylivskii region, Stepanohirska OTG

Sentinel-2



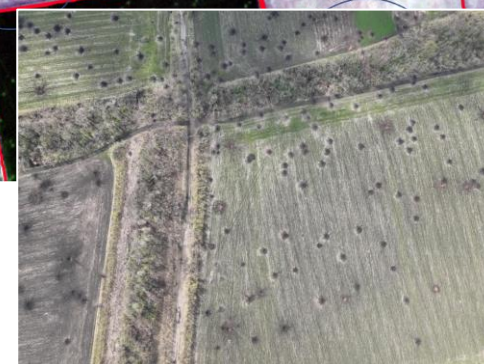
Khersonska oblast, Beryslavskii region, Novovorontsovska OTG

Sentinel-2



Kharkivska oblast, Izum

Drone



EO4UA

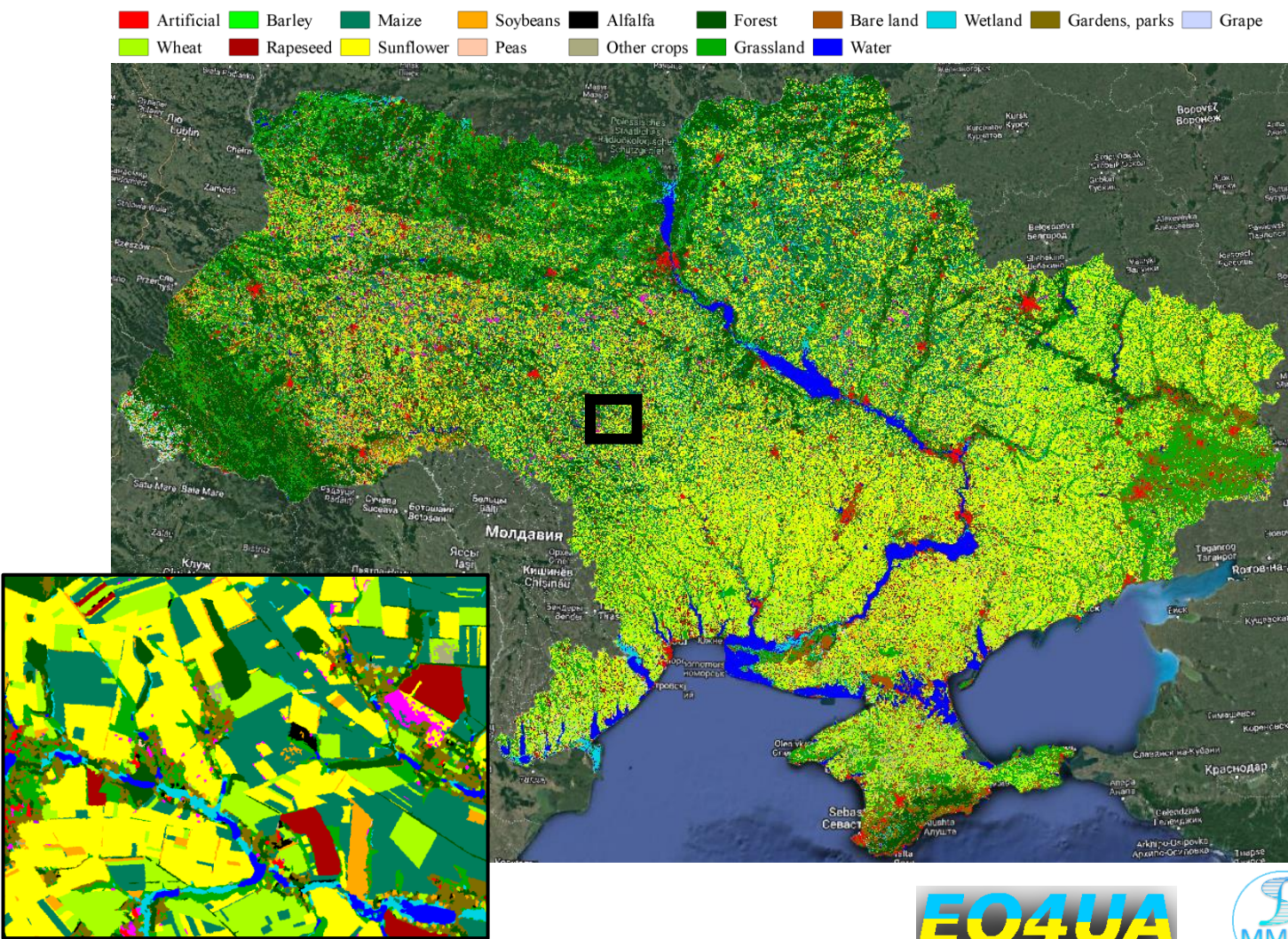




Classification in CREODIAS Cloud

Ukraine 2021

Class	PA	UA	F1
Artificial	96,7	98,2	97,4
Cereal	98,6	99,8	99,2
Rapeseed	98,9	99,7	99,3
Buckwheat	93,1	57	70,7
Maize	97,7	98,3	98
Sugar beet	98,6	91,3	94,8
Sunflower	97,2	99,6	98,4
Soybeans	94,5	92,8	93,6
Other crops	75,5	44,5	56
Forest	99,3	98	98,7
Grassland	96,5	89,2	92,7
Bareland	96,9	44,9	61,4
Water	100	99,9	100
Wetland	92,6	83,1	87,6
Peas	89,3	92,7	91
Alfalfa	63,6	72,3	67,7
Low trees	76,9	86,5	81,4
Grape	91,2	86,4	88,7
Overall Accuracy	97,6		



Summer crop classification 2022



Class	PA (%)	UA (%)	F1 (%)
Artificial	93,2	98,5	95,8
Wheat	96,5	95,5	96
Rapeseed	99,9	100	100
Buckwheat	62,6	93,4	75
Maize	94,8	94,2	94,5
Sugar beet	100	86,7	92,9
Sunflower	98	98,5	98,2
Soybeans	80,3	84,2	82,2
Other crops	70,8	9,2	16,3
Forest	99,9	97,5	98,7
Grassland	95,3	85,2	90
Bareland	94,6	82,5	88,1
Water	99,6	100	99,8
Wetland	91,8	88,9	90,3
Barley	78,3	84,2	81,2
Peas	100	99,1	99,5
Alfalfa	94,8	83	88,5
Gardens, parks	83	97,1	89,5
Grapes	85,9	96,3	90,8
Potato	76,4	100	86,7
OA = 95%			

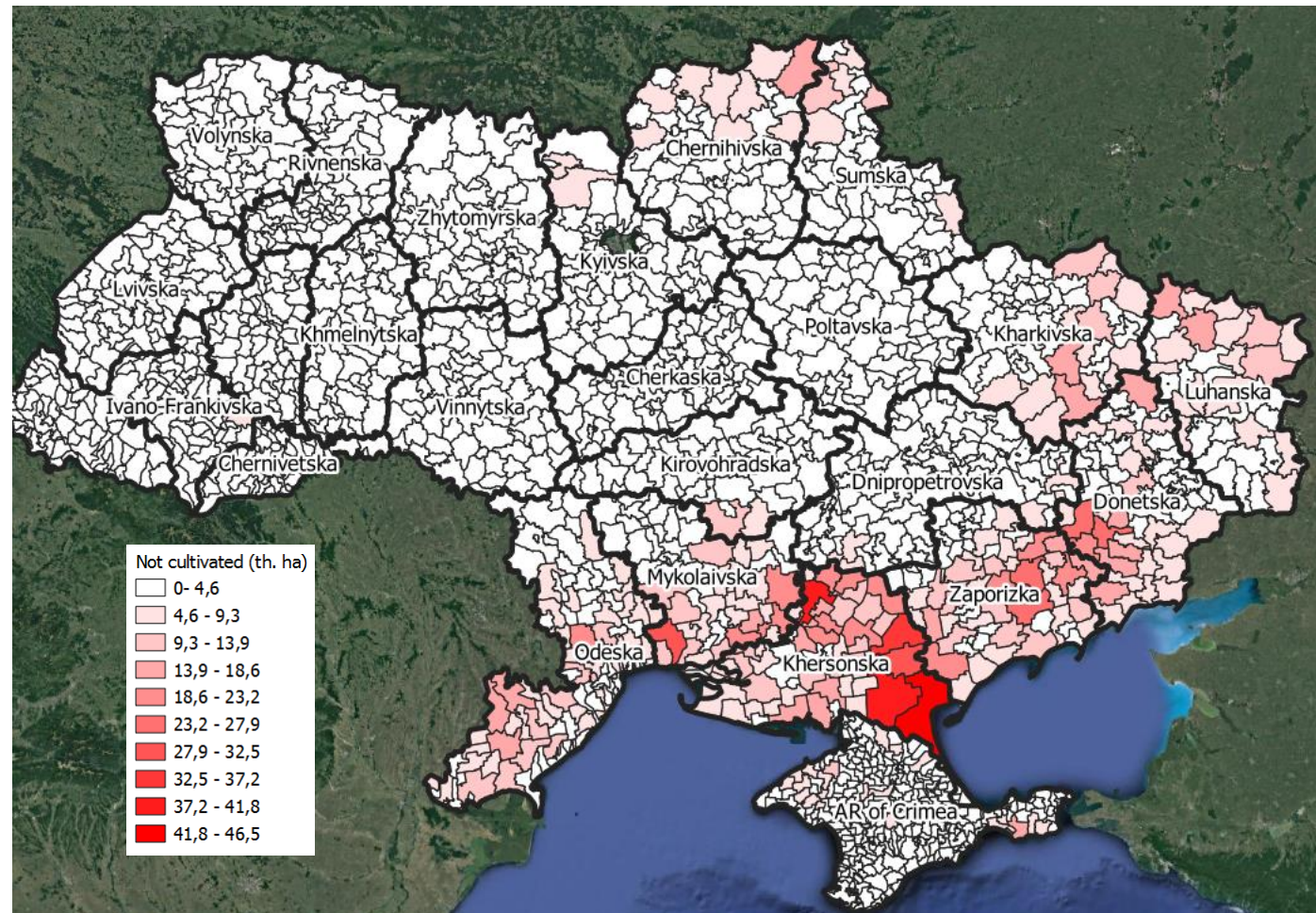




Identification of the non-cultivated Lands

Oblast Biggest with uncultivated cropland	Not cultivated cropland, 2022 Th. ha
Khersonska	672,5
Odeska	497,8
Zaporizka	476,1
Mykolaivska	321,8
Donetska	365,0
Kharkivska	196,8
Luhanska	192,8
Dnipropetrovska	148,0
Sumska	136,0

Total non cultivated area – **4.4 MLN ha**





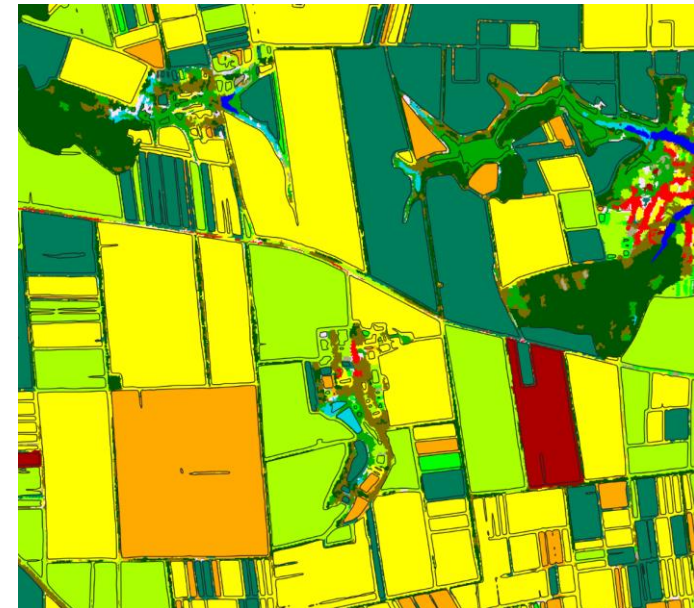
EO4UA synergy

- Parcels delineation (Synergise) has been used for crop type map filtering

Original map

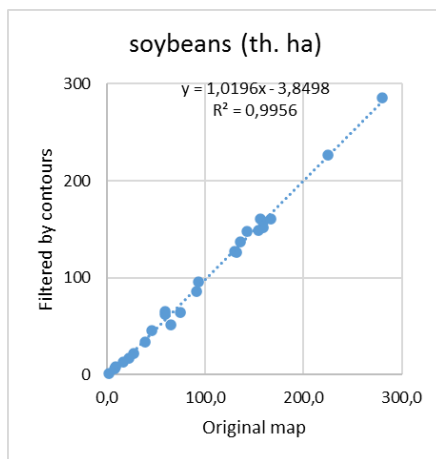
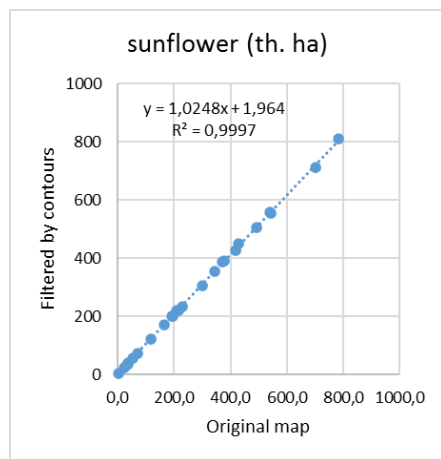
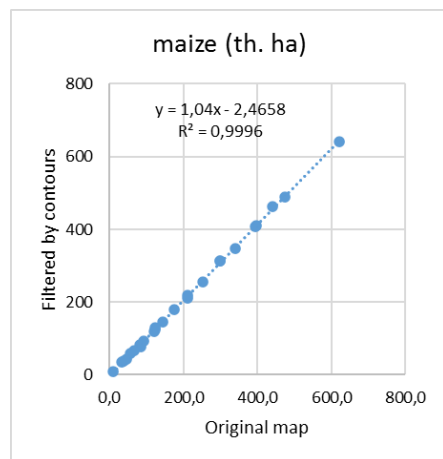
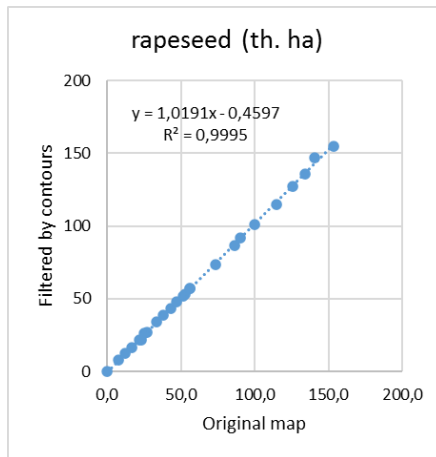
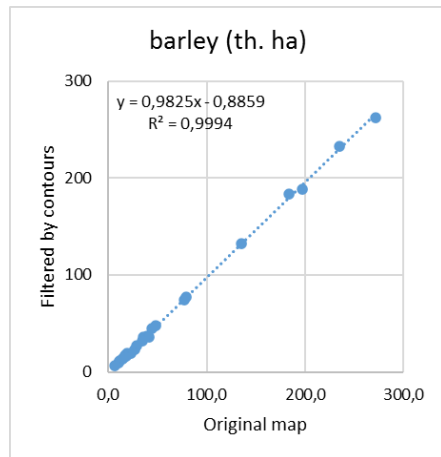
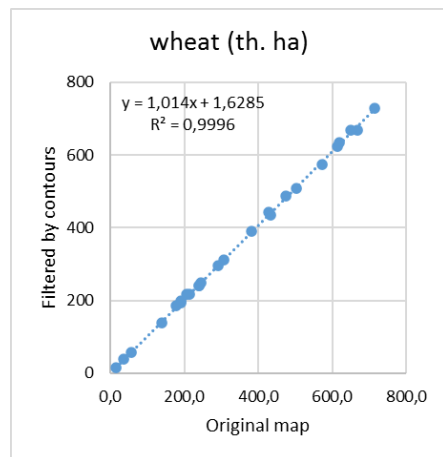


Filtered by contours

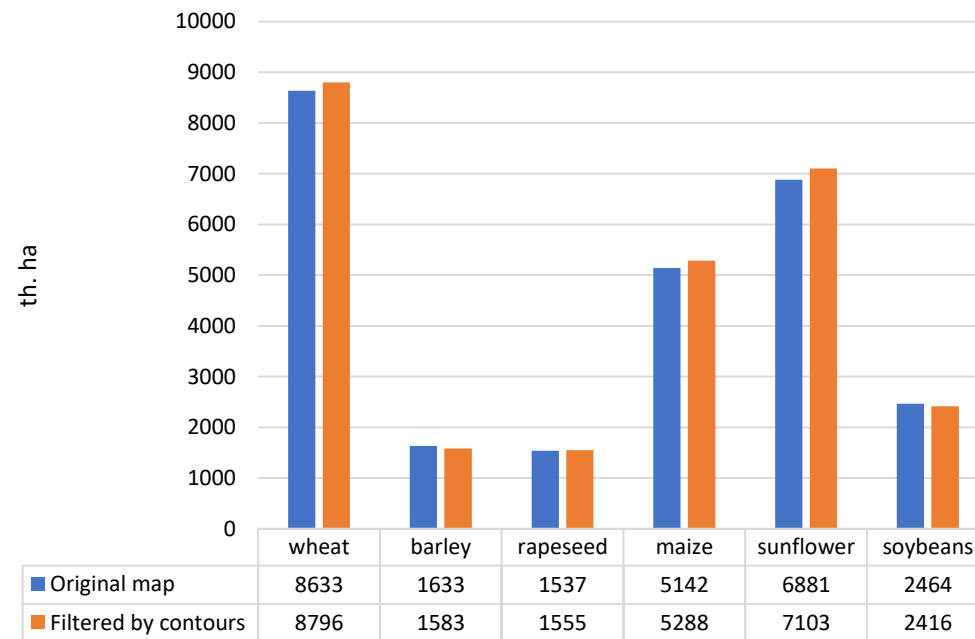




Area estimation (oblast level)



Comparison of "original" area and filtered by contours (country level)





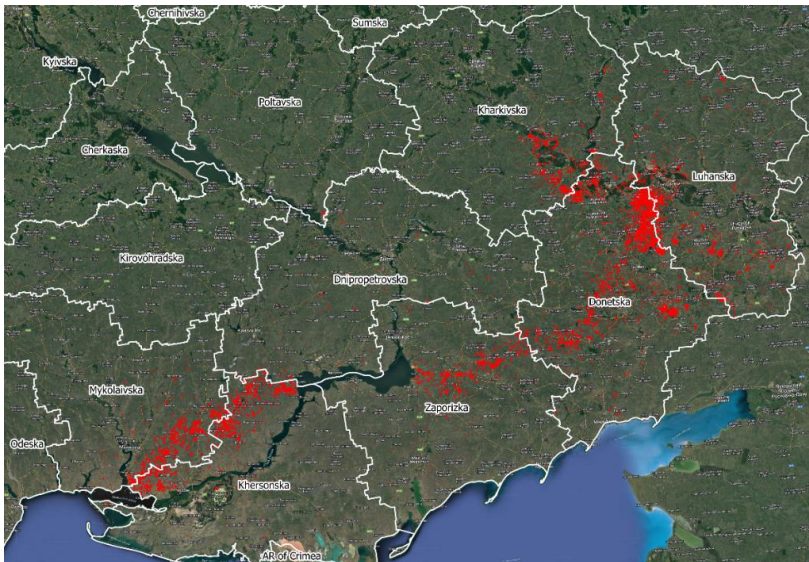
Fires detection (July 2022)

Overall burned area is **104.2 th. ha**

- 70 th. ha – cereal crops
- 7.8 th. ha – summer crops
- 25 th. ha – grassland

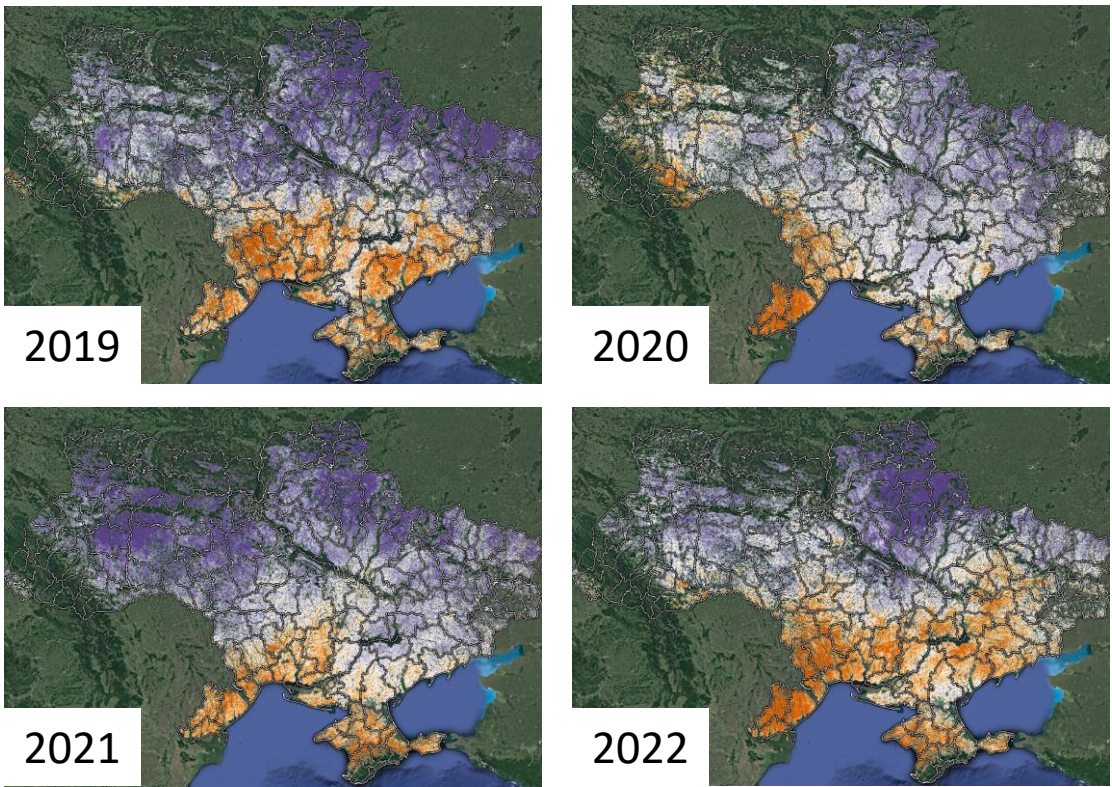
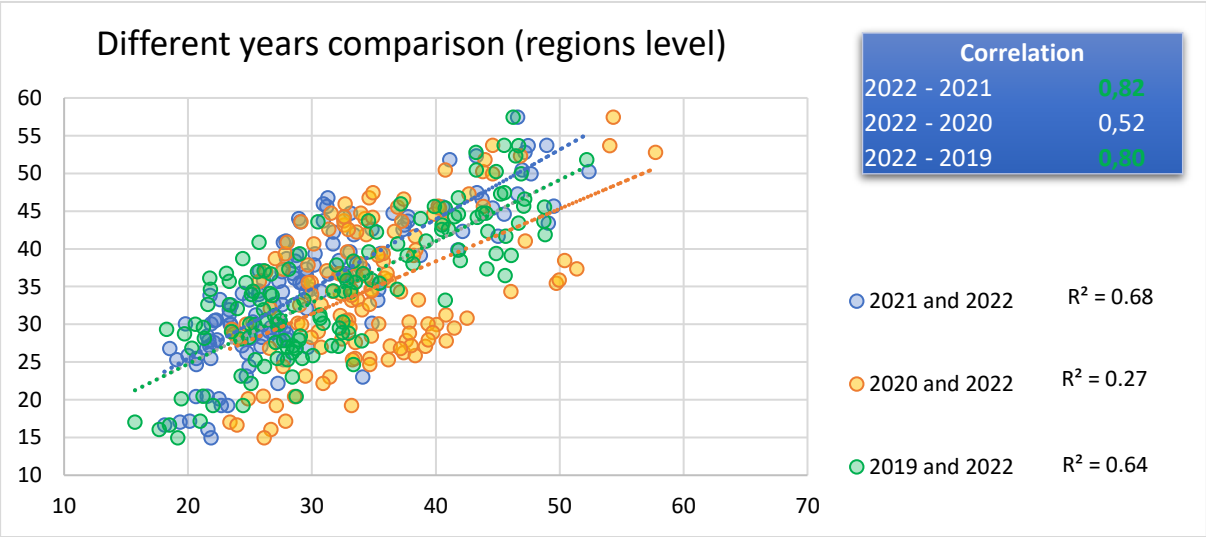
Damaged **317 th. tons** of grain

	Cereal	Rapeseed	Summer crops	Grassland	Forest	Total (ha)
Donetska	25823,7	4,3	144,8	10122,6	266,3	36361,6
Khersonska	10843,2	87,3	4129,4	4684,9	150,6	19895,3
Mykolaivska	14556,3	41,0	1398,2	2964,9	286,8	19247,1
Zaporizka	9173,0	81,2	1774,7	1448,5	61,4	12538,8
Luhanska	3396,0	30,1	175,3	4859,1	287,7	8748,2
Kharkivska	5395,0	0,1	43,2	769,0	87,1	6294,4
Dnipropetrovska	745,6	7,7	152,4	163,0	2,5	1071,2
Poltavska	45,1	13,1	1,0	0,9	0,0	60,1
Odeska	3,0	0,0	7,7	1,8	0,0	12,6





Land surface temperature in CREODIAS (Sentinel-3)



1 Oct. 2021 – 1 Apr. 2022



WORKING PAPER

Quantifying War-Induced Crop Losses in Ukraine in Near Real Time to Strengthen Local and Global Food Security



English ▾



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15% yield reduction in 2022
output loss of **4.2 million tons** of
winter cereal

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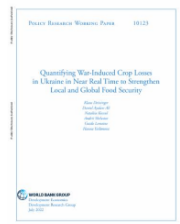
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Quantifying War-Induced Crop Losses in Ukraine in Near Real Time to Strengthen Local and Global Food Security



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This paper uses a 4-year panel (2019–2022) of 10,125 village councils in Ukraine to estimate direct and indirect effects of the war started by Russia on area and expected yield of winter crops. Satellite imagery is used to provide information on direct damage to agricultural fields; classify crop cover using machine learning; and compute the Normalized Difference Vegetation Index (NDVI) for winter cereal fields as a proxy for yield. Without conflict, winter crop area would have been 9.14 rather than 8.38 mn. ha, a 0.75 mn. ha reduction, 86% of which is due to economy-wide effects. The estimated conflict-induced drop in NDVI for winter cereal, which is particularly pronounced for small farms, translates into a 15% yield reduction or an output loss of 4.2 million tons. Taking area and yield reduction together suggests a war-induced loss of winter crop output of 20% if the current winter crop can be harvested fully.

AUTHOR PROFILES

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ABSTRACT VIEWS
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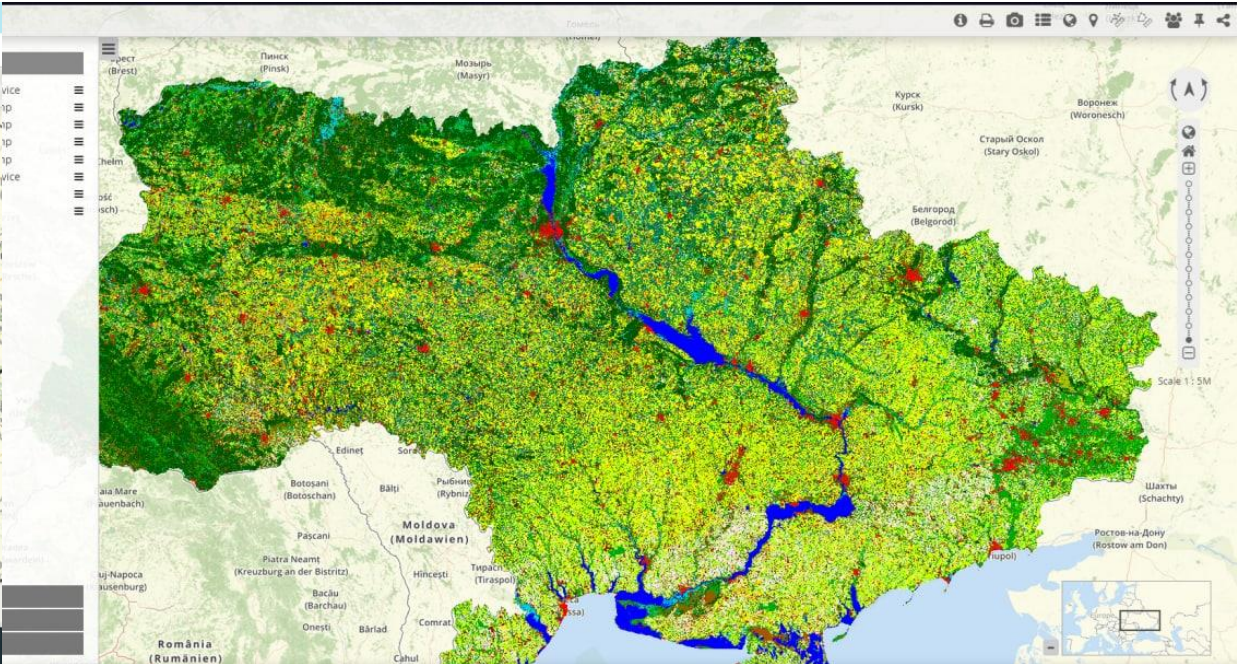
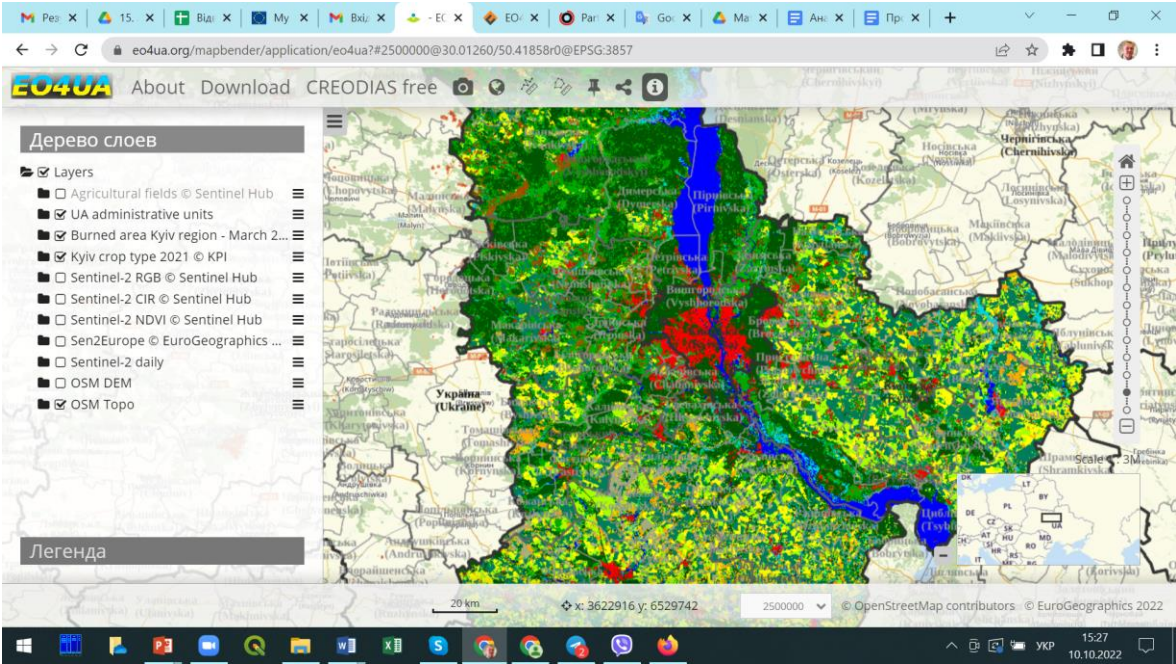
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<https://openknowledge.worldbank.org/handle/10986/37665>



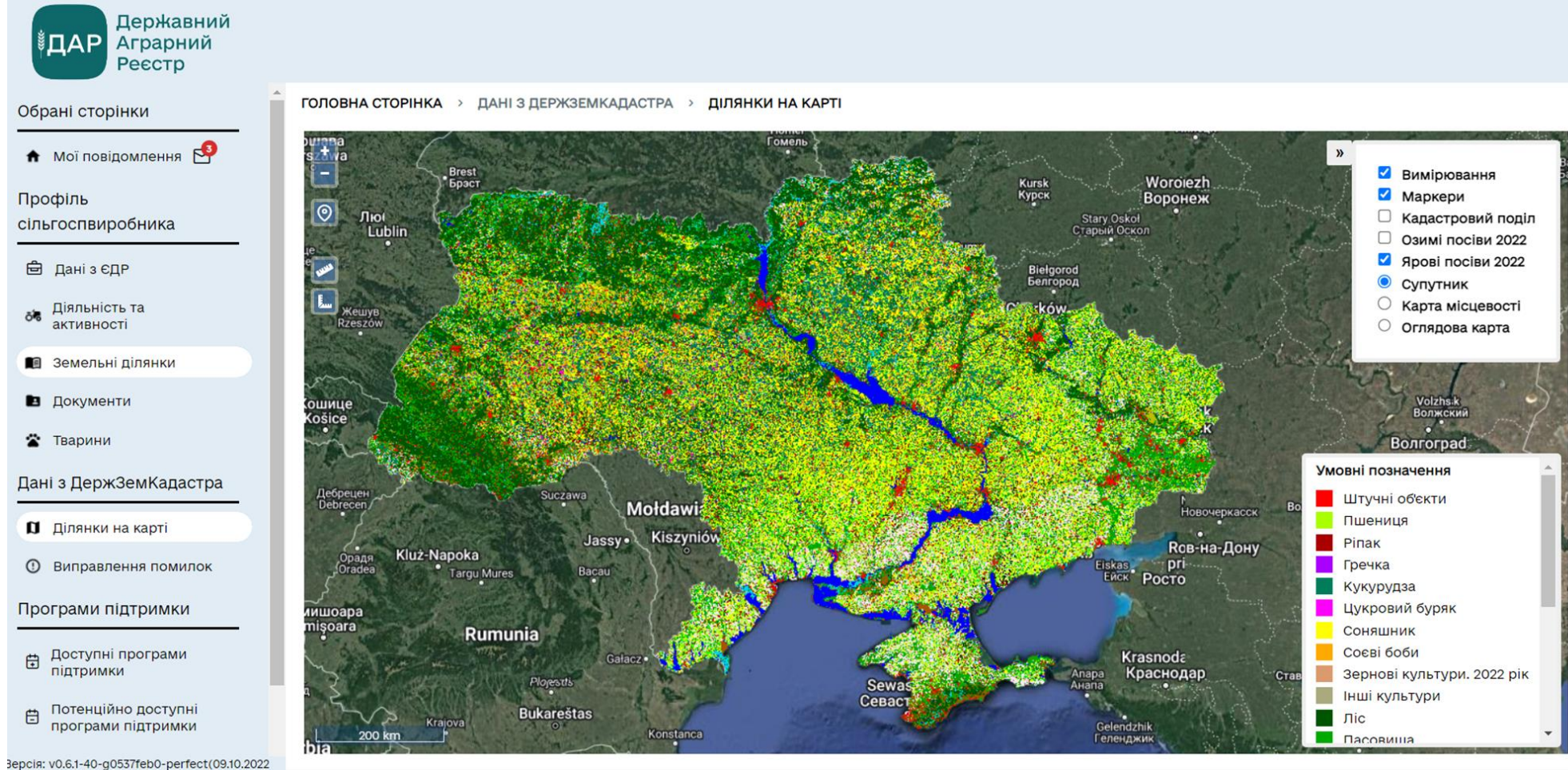


GeoPortal Demo (Cloud-based)





Crop map in the State Agrarian Register



<https://reg.dar.gov.ua/farmer/landparcelsonmap>

EO4UA



OCRE4Ukraine – Quantifying war damage in Ukraine based on EO data in support of EO4UA initiative

- **Goal:** Quantifying war damage in Ukraine based on EO data in support of EO4UA initiative
- **Coordinator** - Anhalt University of applied science
- **German-Ukrainian Center of excellence** (<https://aidati.org>)

“AIDA-TI: AI-aided Data Analysis and Data Transport Infrastructures”

- **Partners:**

- Anhalt University of applied science (Germany)
- University of Konstanz (Germany)
- NTUU “KPI” (Ukraine)
- Space Research Institute (Ukraine)





OCRE4Ukraine as EU OCRE Project

- OCRE Project - Open Cloud for Research Environments” (Horizon 2020)
 - Access to > 31 PB of full and open high resolution EO data sets and relevant reference data
 - Very high connectivity bandwidth on the internal networks, and high throughput connection to GEANT2
 - Jupyter Notebook interface
 - Data discovery services to EO data repository with open API

OCRE4Ukraine Objectives



- To **expand existing crop monitoring methodology** to new regions and assess war damages based on EO data using advanced machine learning algorithms deployed within cloud infrastructure.
- To establish **close collaboration with Ukrainian researchers** (i.e. Kyiv Polytechnic Institute, Polissia National University, Space Research Institute) within the community-driven EO4UA initiative that will benefit/promote the results acquired within the proposed OCRE project.
- To **prepare for prospective inclusion of Ukraine within the EU** to facilitate technology transfer (including cloud computing) from member states to Ukraine.



Impact

- Strengthening the **European** Research environment in the area of Earth observation and **integration of Ukraine** into it
- **Extending the best EU practices** and innovations to Ukraine in a mutually beneficial way
- Contribution to the **restoration of Ukraine** and moving to sustainable economic environment with focus on Green Deal, Common Agricultural Policy (CAP) and Land Parcel Identification System (LPIS)
- Continuation of **digitalization and intellectualization** of the **economies** of Europe and the Eastern Partnership countries
- Contribution to AI and machine learning **algorithms and applications** aimed at supporting **big data processing** in **strategic areas** such as **climate change**, green deal, sustainable development, strategic planning, economical and **business analytics**



Stand with Ukraine!



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EO4UA

