



Crop harvesting analysis Ukraine 2023

VISTA GmbH, Munich
www.vista-geo.de

Final Presentation



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Network of Resources
ID 3a06VS





1. Welcome (ESA)

2. Methodology

- Yield forecast in YPSILON
- Refinement of the 2023 summer crops classification
- Impact of frontline and destruction of critical infrastructure for agriculture

3. Crop analysis Ukraine 2023

- For winter wheat, winter barley, rapeseed, spring barley, grain maize and sunflower
- Yield results at oblast and raion level
- Percentage of change in the area under cultivation
- Total production compared to previous years

4. Overview of crop analysis and comparison to other estimations

5. Discussion and questions



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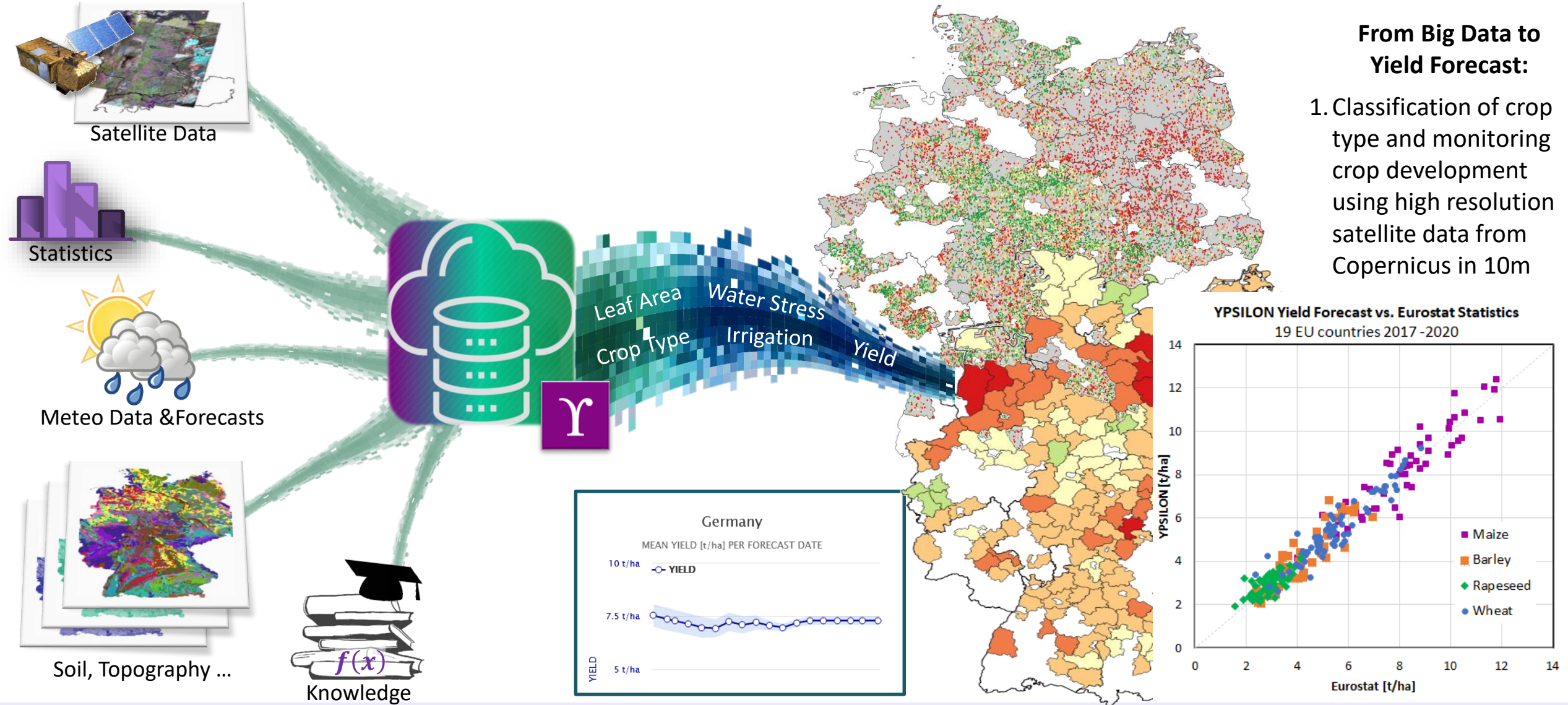
2. Methodology

- Yield forecast in YPSILON
- Refinement of the 2023 summer crops classification
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Heike Bach, Solveig Blöcher



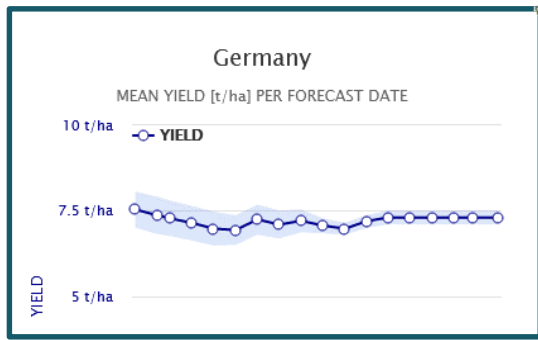
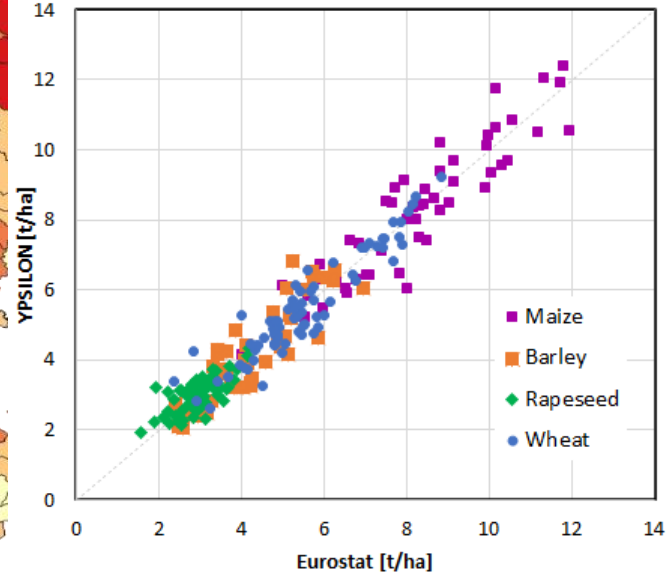
YPSILON - Yield Prediction by Satellite



From Big Data to Yield Forecast:

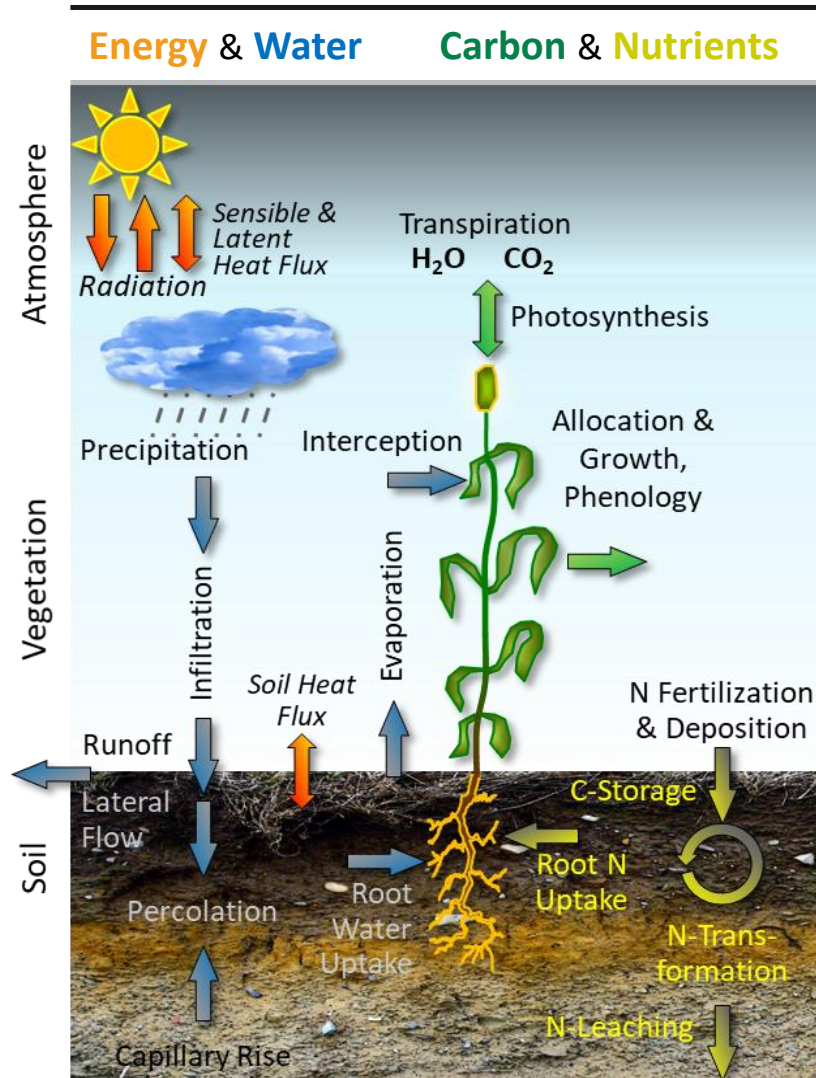
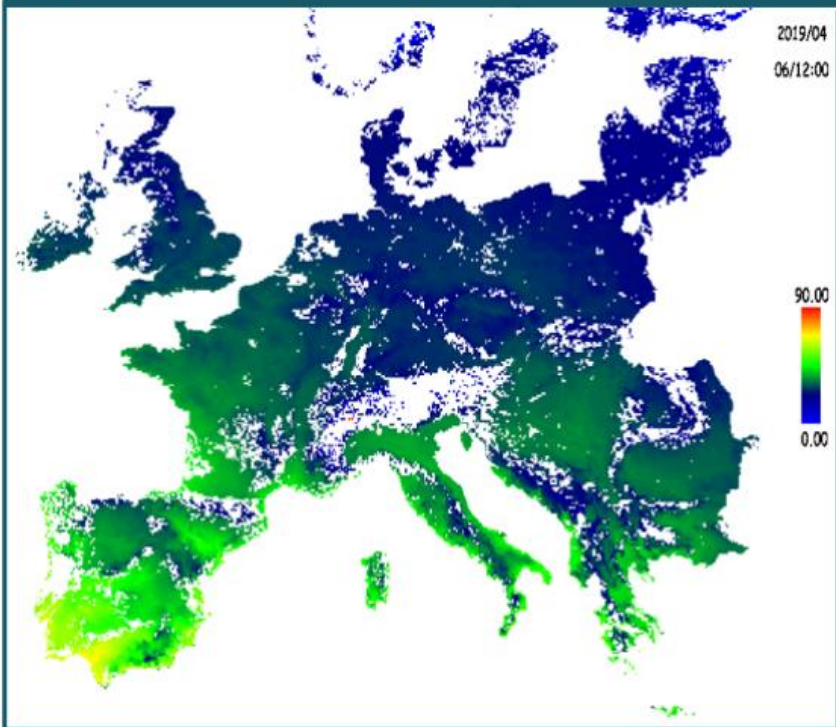
1. Classification of crop type and monitoring crop development using high resolution satellite data from Copernicus in 10m

YPSILON Yield Forecast vs. Eurostat Statistics
19 EU countries 2017-2020



PROMET – Simulation of the Water-Energy-Food-Nexus (crop production, energy balance, water-, carbon- and nitrogen cycles)

PROMET simulates crop growth, yield and all relevant land surface processes under different agricultural management alternatives e.g. wheat phenology in Europe:



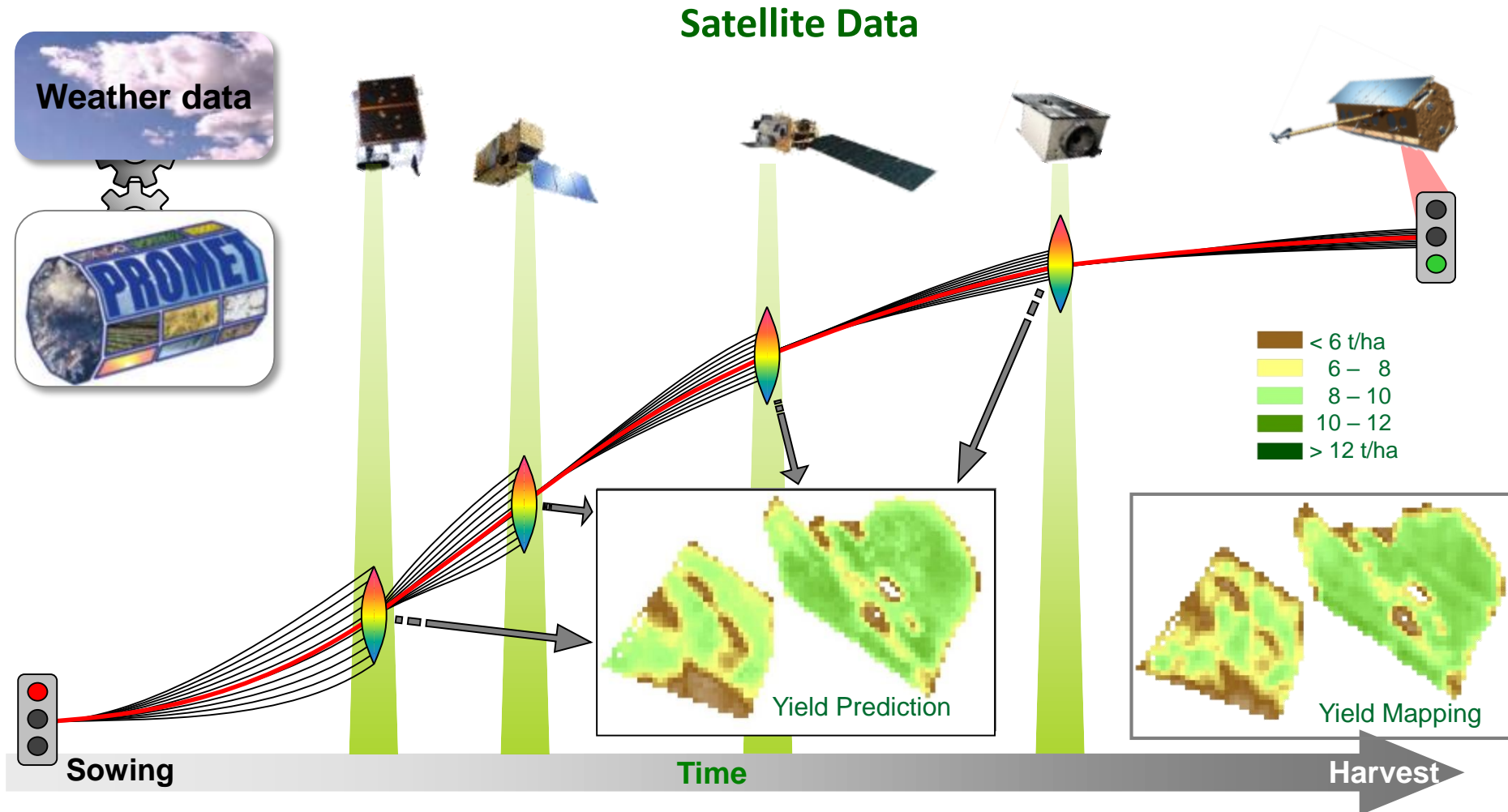
PROMET:



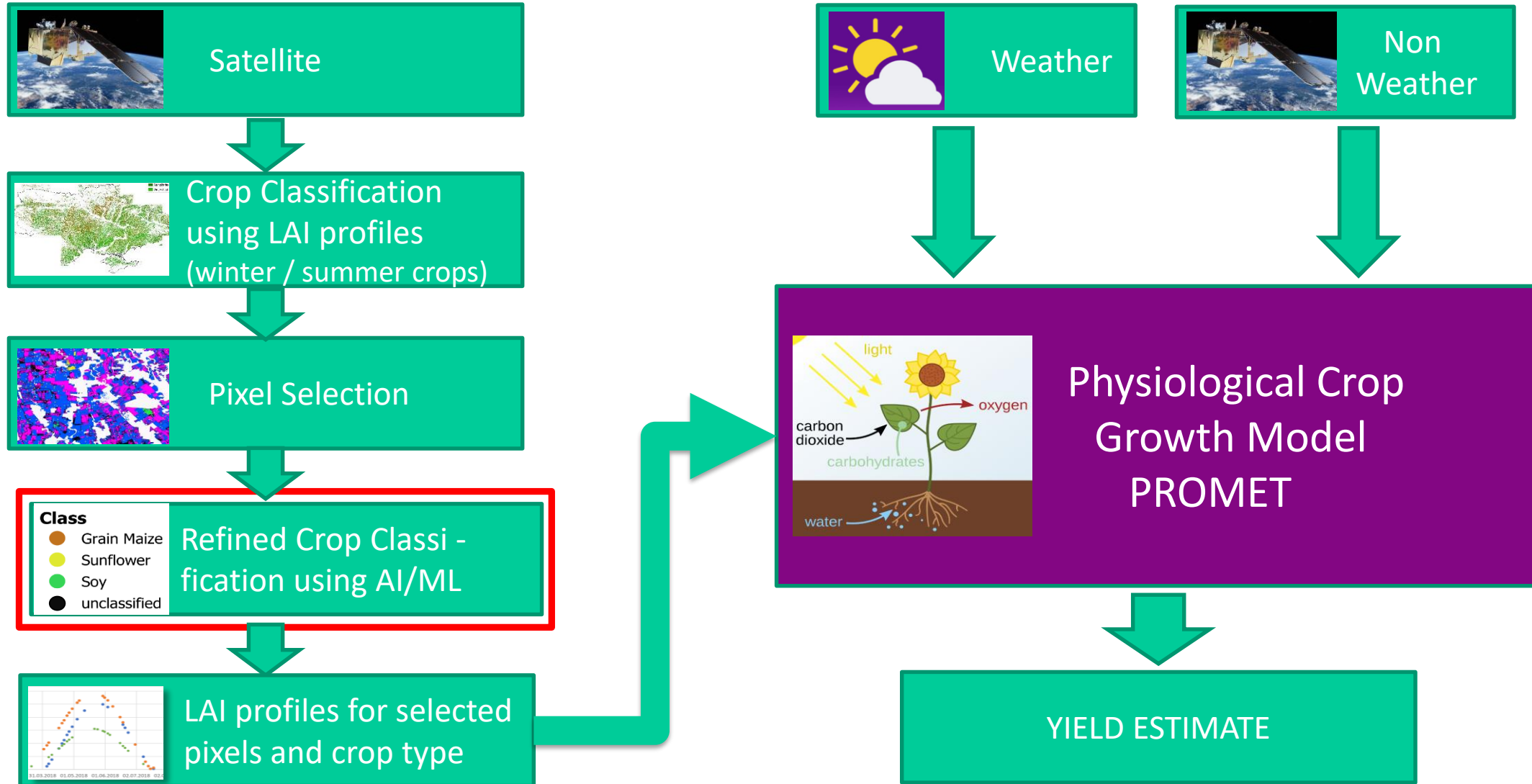
- is a fully spatial agricultural simulator owned by Vista.
- is well accepted in science and tailored for application.
- is based on first order physical and physiological principles and laws
- is designed to assimilate spatial parameters from remote sensing
- can simulate management scenarios
- has proven its value from field to Globe and for applications ranging from smart farming to Climate Change impact analyses.



Utilisation of satellite data in VISTAs plant growth model PROMET

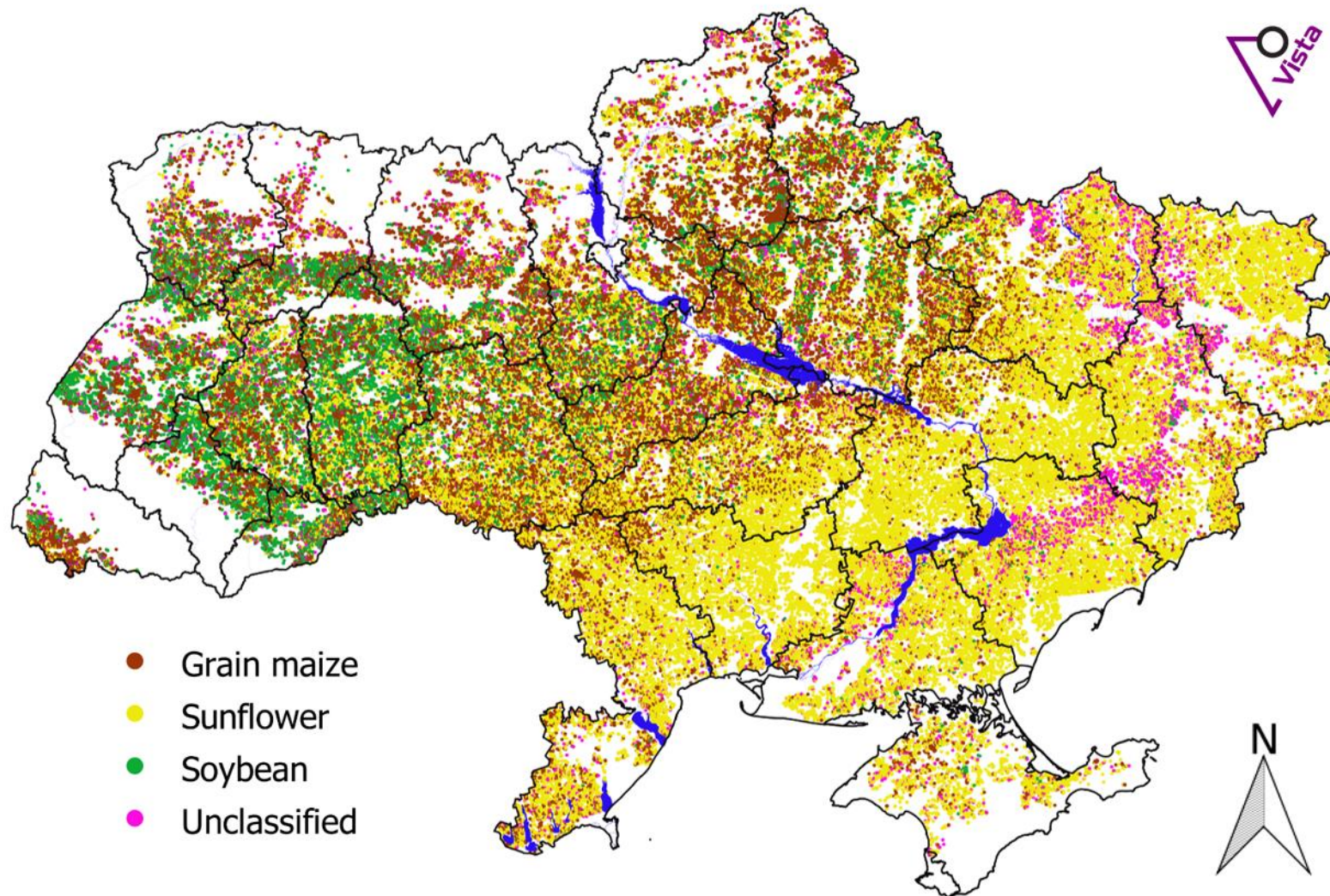


Schematic Workflow YPSILON





2023 summer crops classification



Distribution of sample fields

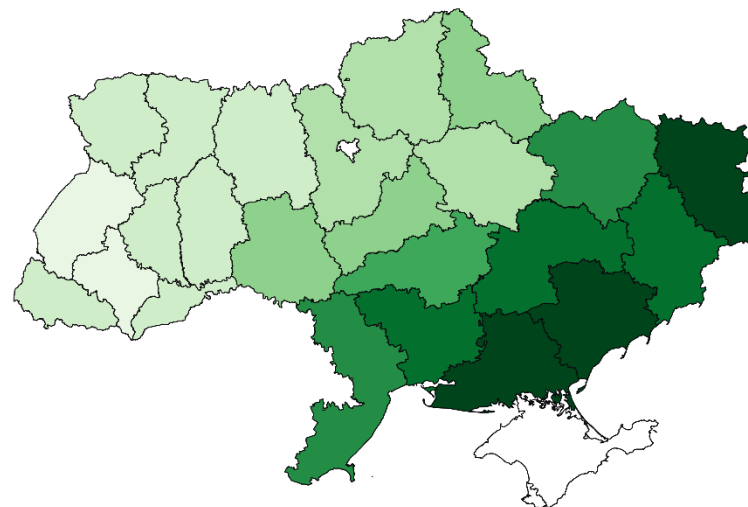
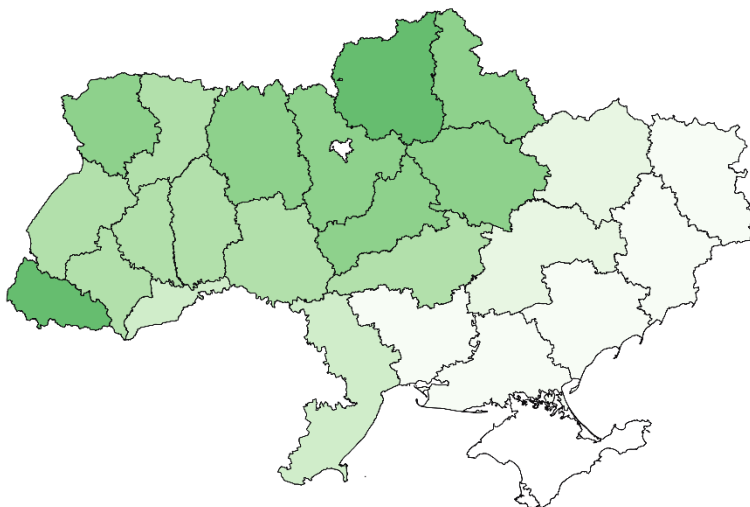
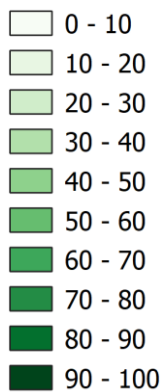
Sunflower:	50.6 %
Grain maize:	27.2 %
Soybean:	14.2 %
Unclassified:	8.0 %

2023 summer crops classification: Comparison of distribution of grain maize and sunflower on Oblast level

VISTA Classification 2023

Grain maize

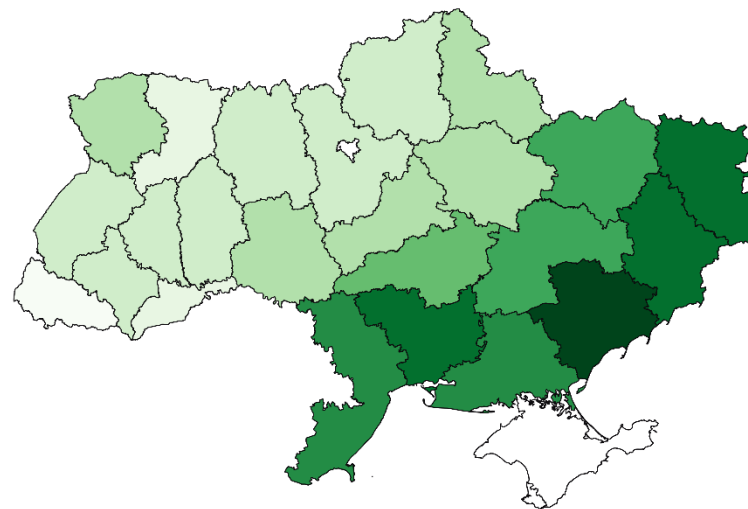
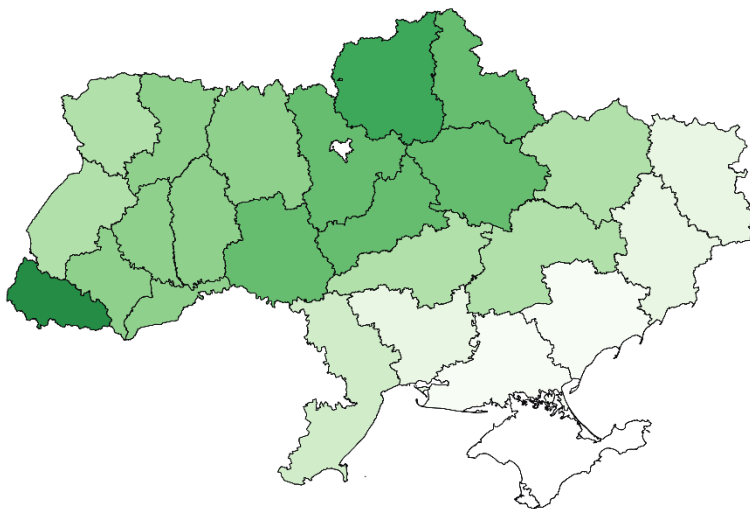
Sunflower



Distribution within classification

Sunflower: 54.3 %
Grain maize: 29.4 %
Soybean: 16.3 %

Statistics 2017 - 2021

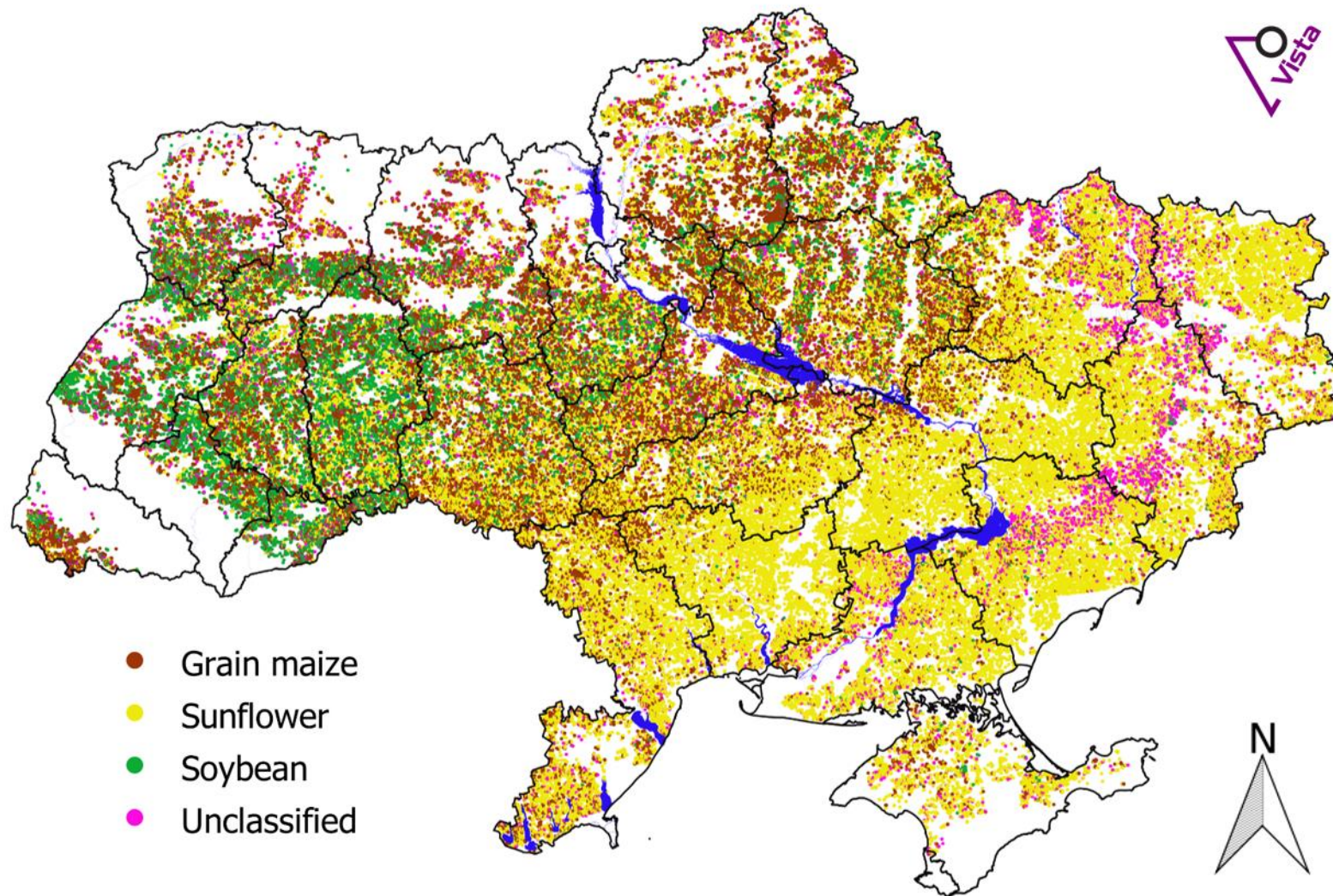


Distribution of acreage in 2017 - 2021

Sunflower: 49.4 %
Grain maize: 38.3 %
Soybean: 12.2 %

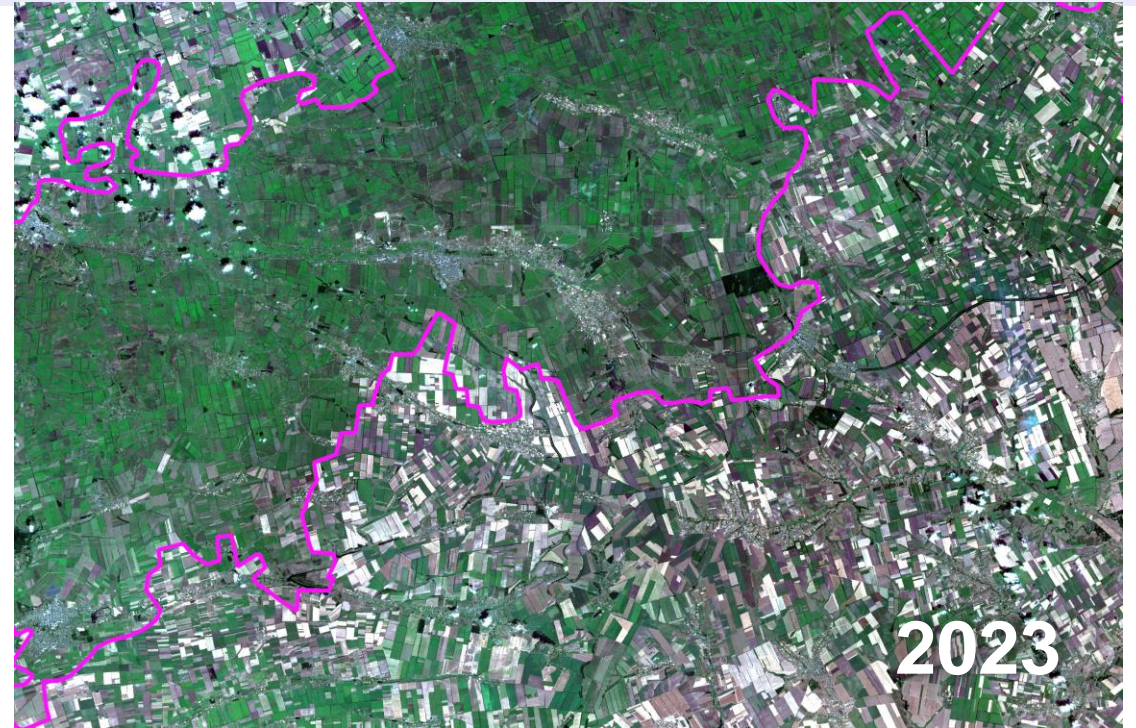


2023 summer crops classification





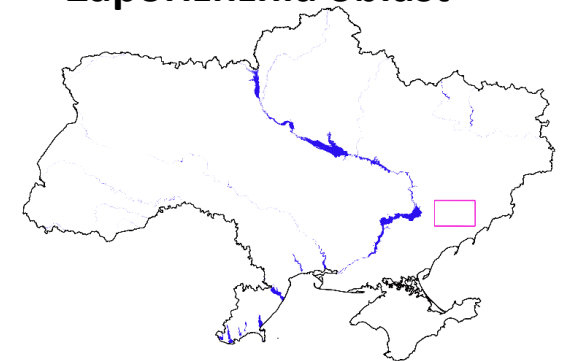
Impact of Frontline in Ukraine 2023



contains Copernicus data (2023 & 2021)

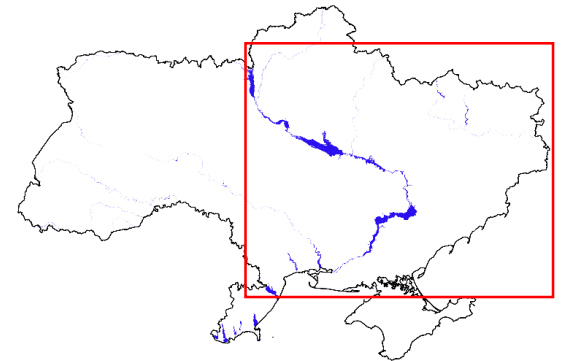
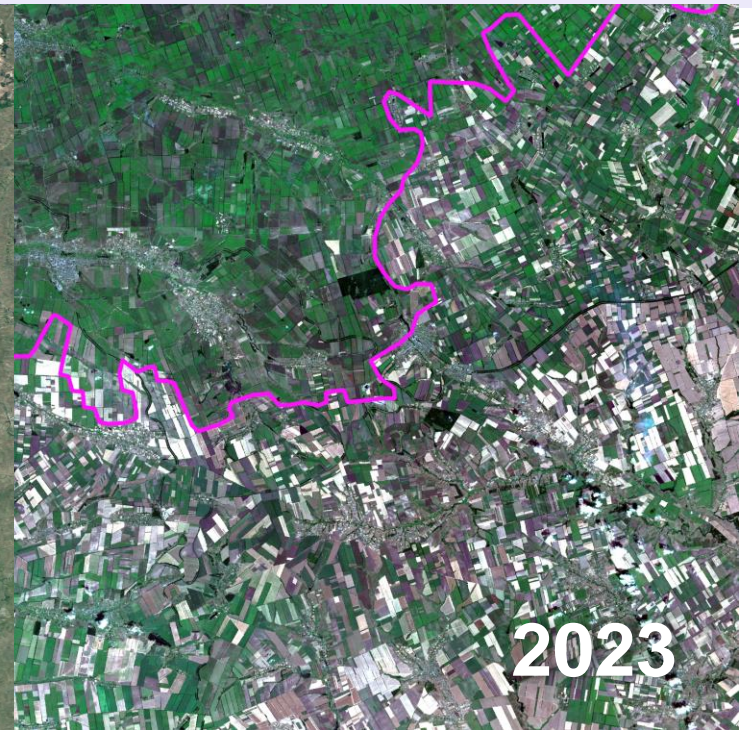
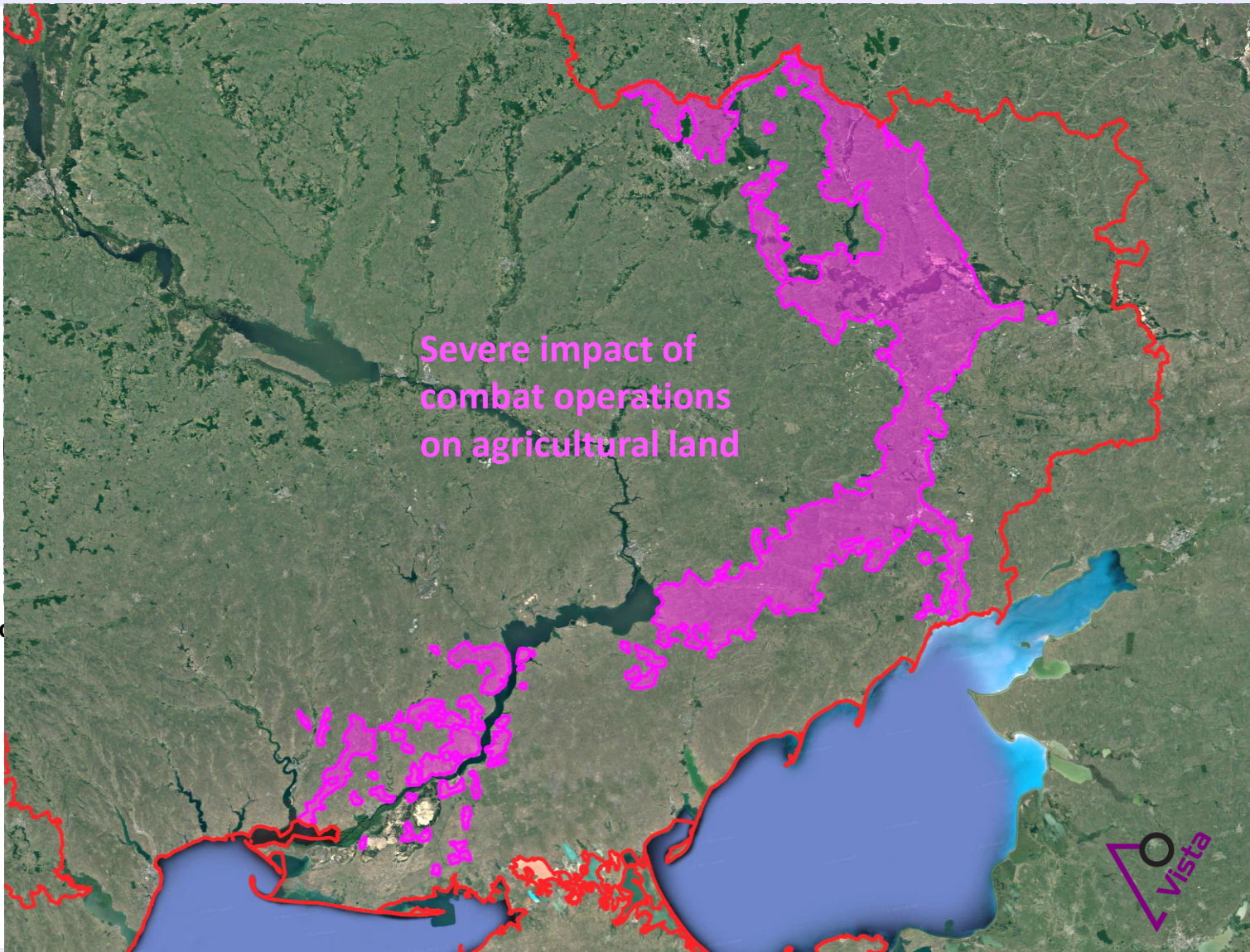
Zaporizhzhia oblast

Along the frontline, optical images revealed significant landuse changes in 2023. Vegetation develops but they are not used for food production.



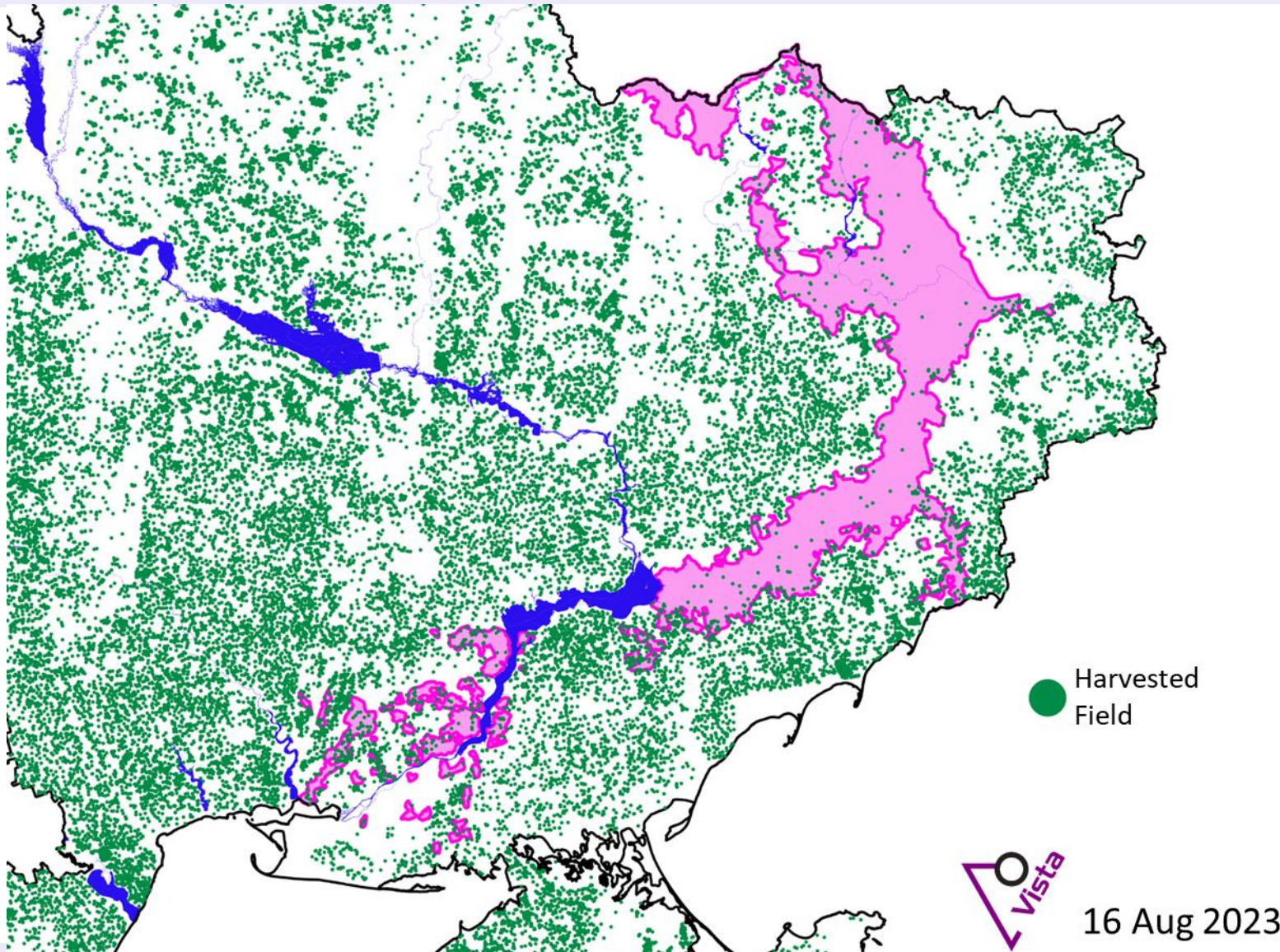


Impact of Frontline in Ukraine 2023

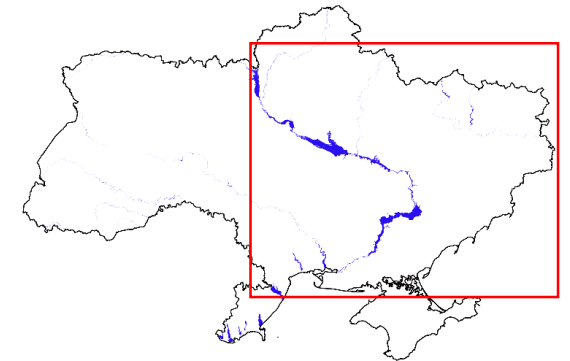




Monitoring of Agricultural Activities (wheat harvest) along the frontline in 2023

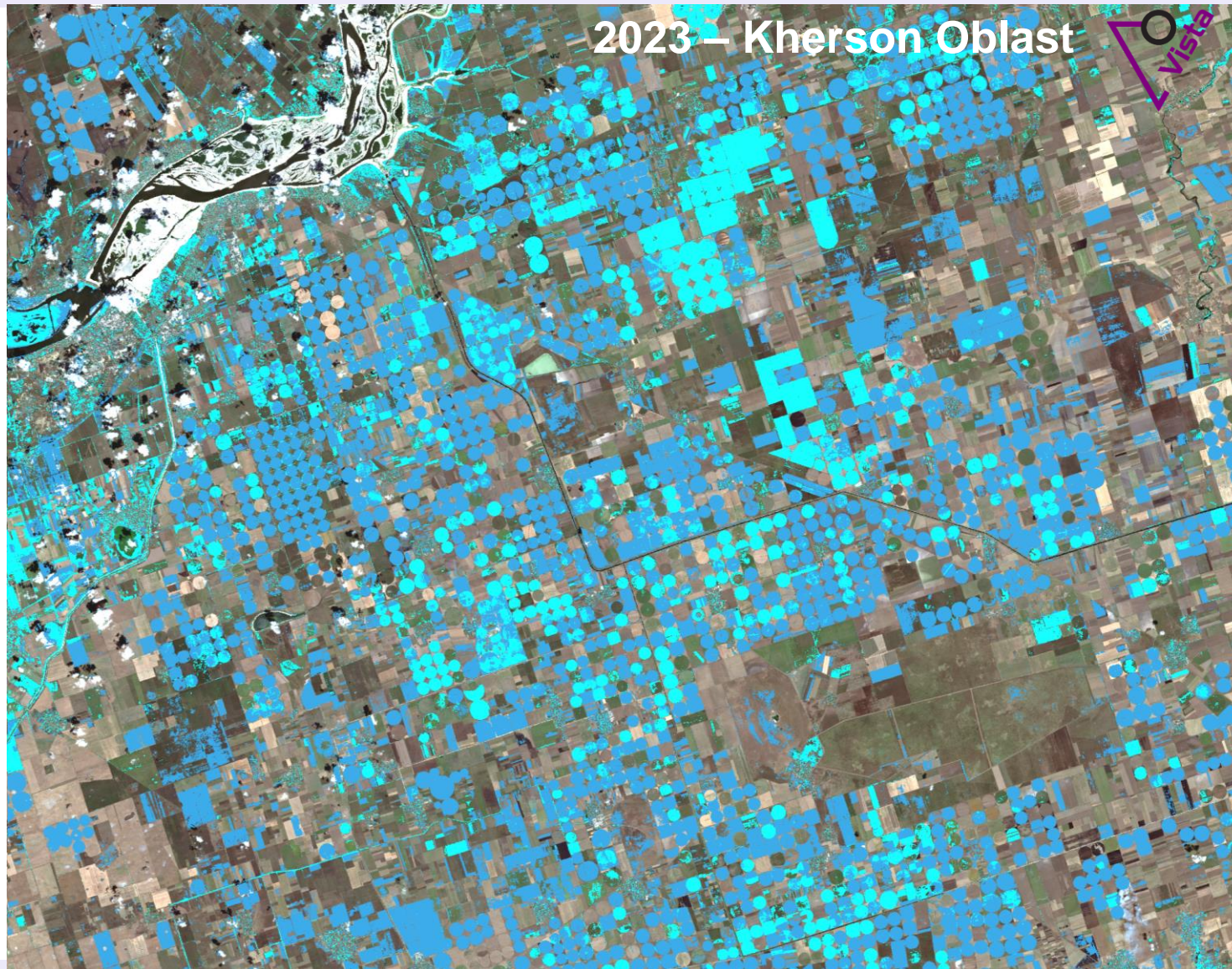


Optical data and SAR harvest activity monitoring both reveal the same picture: 6.5% of the agricultural area of Ukraine (Crimea excluded) could not be used for agricultural production in 2023 along the frontline.





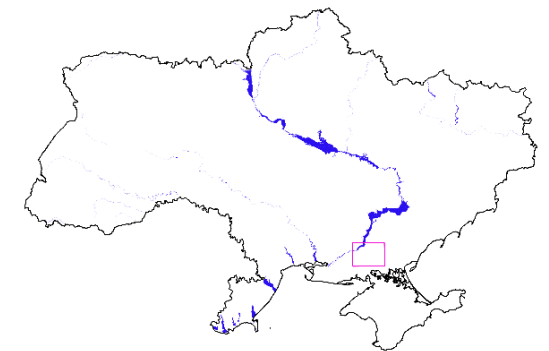
Impact of destruction of critical infrastructure for agriculture



Irrigated
in 2023

Irrigated
in 2021

Dam breakage in 2023
reduced irrigated area by
52% in Kherson oblast and
thus agricultural production.





3. Crop analysis Ukraine 2023

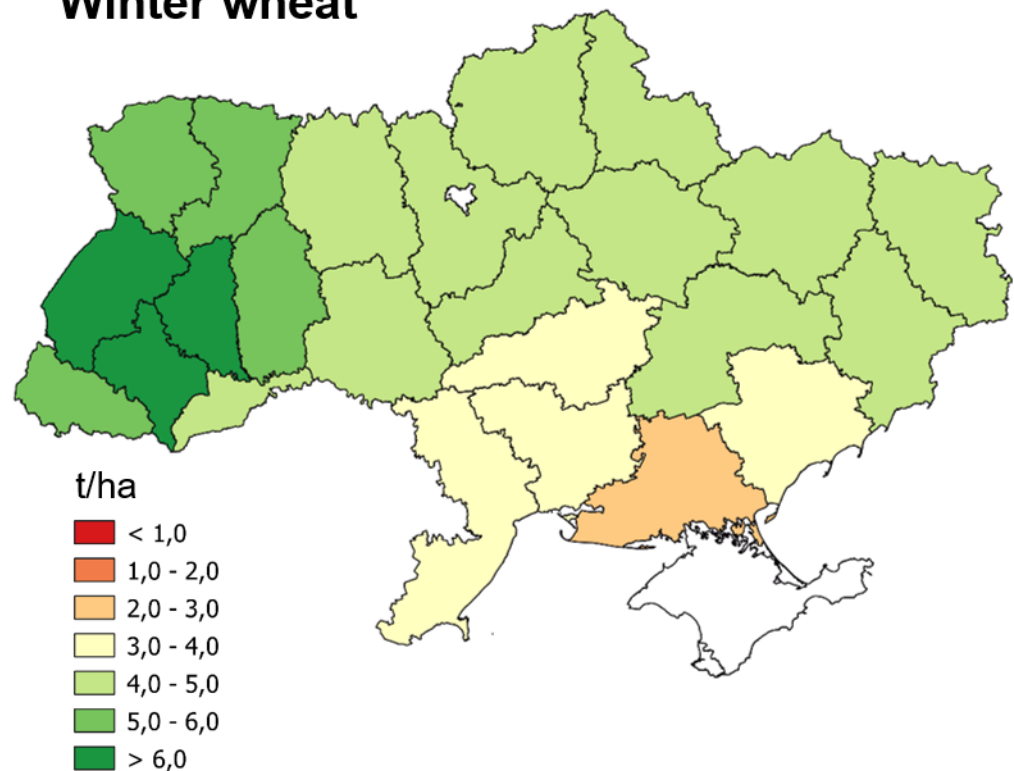
- for winter wheat, winter barley, rapeseed, spring barley, grain maize and sunflower
- Yield results at oblast and raion level
- Percentage of change in the area under cultivation
- Total production compared to previous years
- Harvested area

Christian Miesgang, Solveig Blöcher, Florian Appel

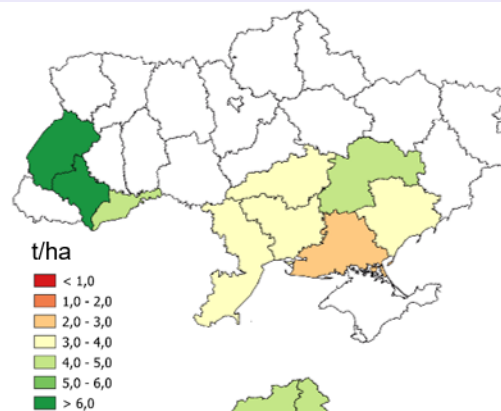


Yield results at oblast level in t/ha

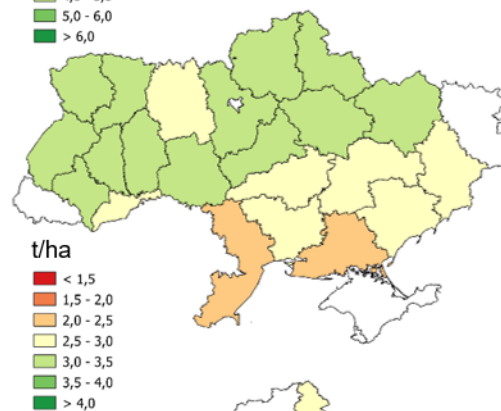
Winter wheat



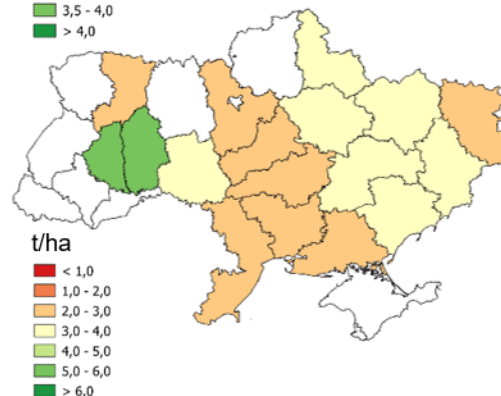
Winter barley



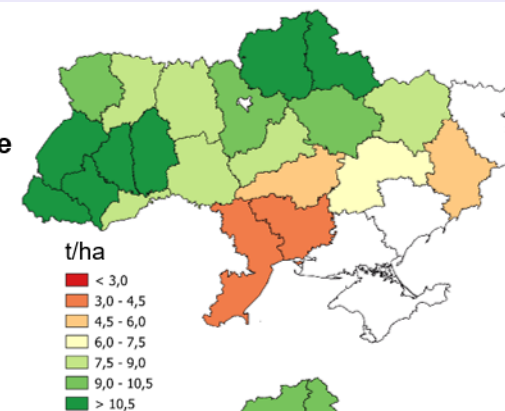
Rapeseed



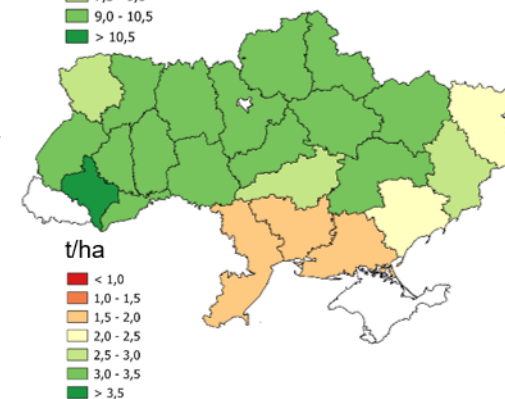
Spring barley



Grain maize



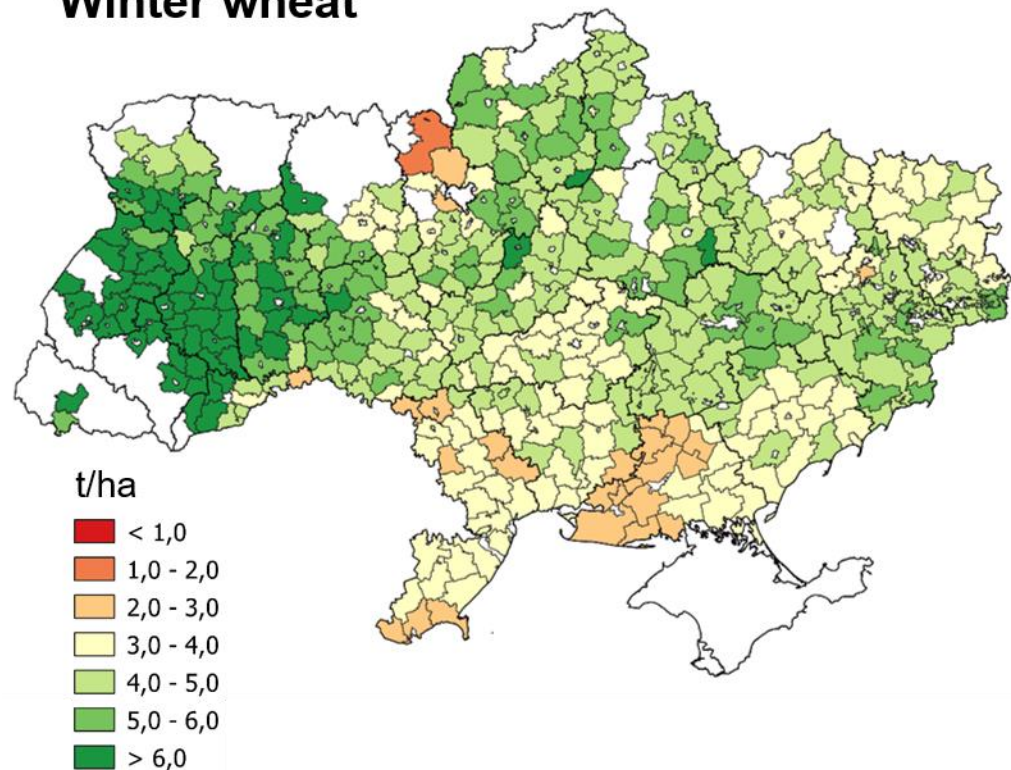
Sunflower



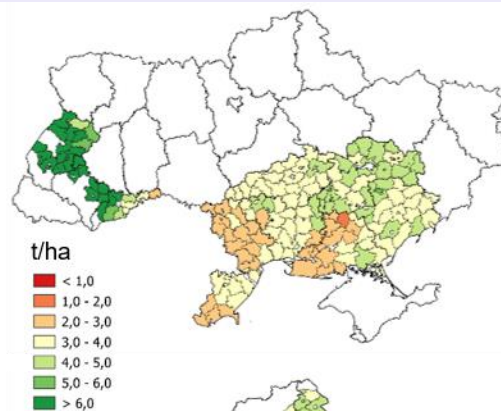
Data set will be delivered to ESA and Ukrainian Ministry of Agriculture

Yield results at raion level in t/ha

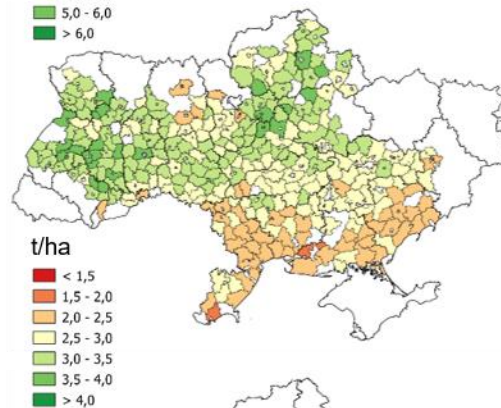
Winter wheat



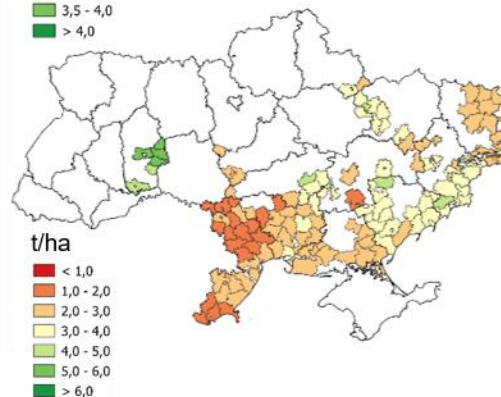
Winter barley



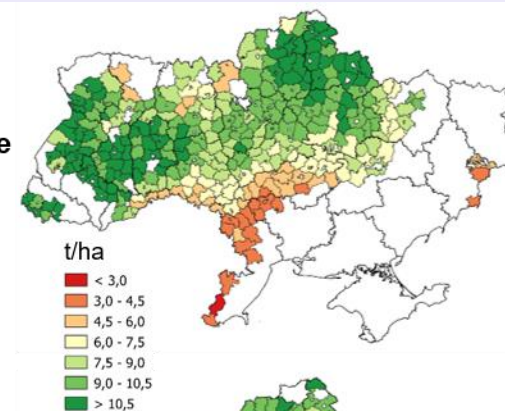
Rapeseed



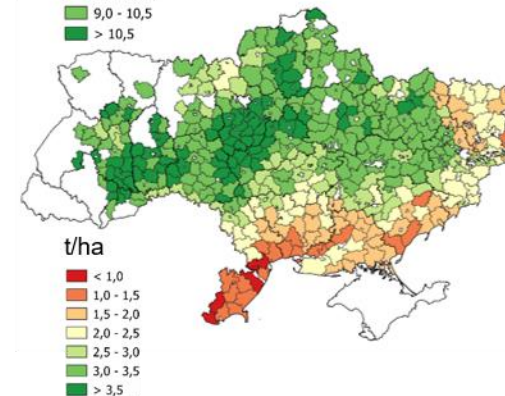
Spring barley



Grain maize



Sunflower



Even more detailed view
on agricultural production
then oblast level



Ukraine 2023 Winter Wheat

Yield Prediction Report

Status: 2023-08-09

Summary Report: Yield Prediction winter wheat 2023

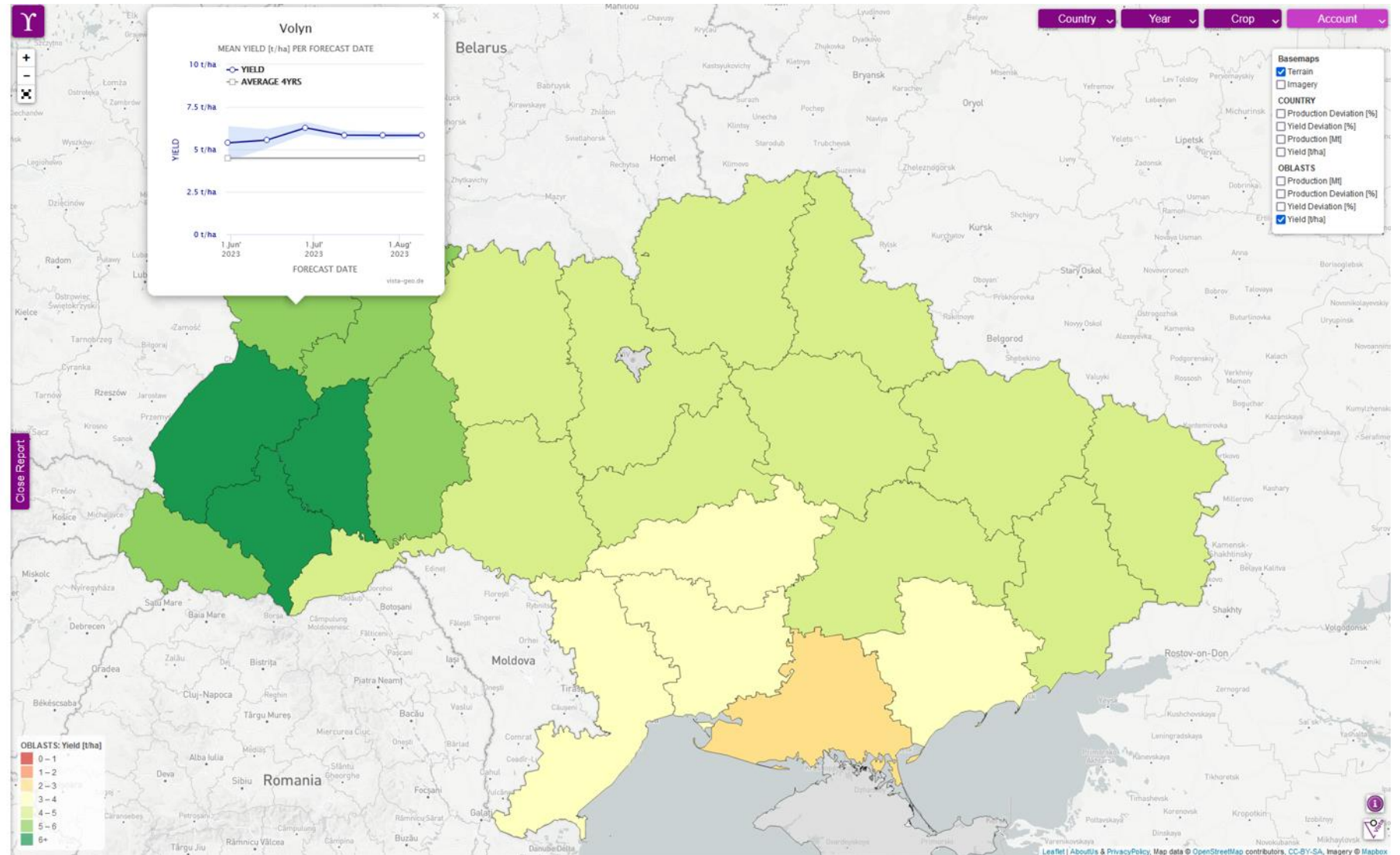
We expect an average yield of 4.43 t/ha with an uncertainty range of 4.28 - 4.58 t/ha. With an acreage of 5689 [1000 ha]* this results in a production of 25.19 Mt (-7% compared to the average production over 2018 to 2021) with an uncertainty range of 24.34 - 26.04 Mt. *Areas based on JRC MARS Bulletin reports, adjusted with EO analysis by VISTA (Crimea excluded).

The YPSILON yield forecast uses weather data, high resolution satellite data and a physically based crop growth model. The satellite data first give us information on the currently grown crops. About 65.000 sampling points distributed representatively over Ukraine are then monitored daily over the growing season. Observed biomass development is integrated in the crop growth model to simulate yield formation and forecast date of harvest.

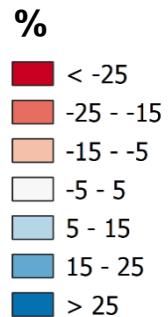
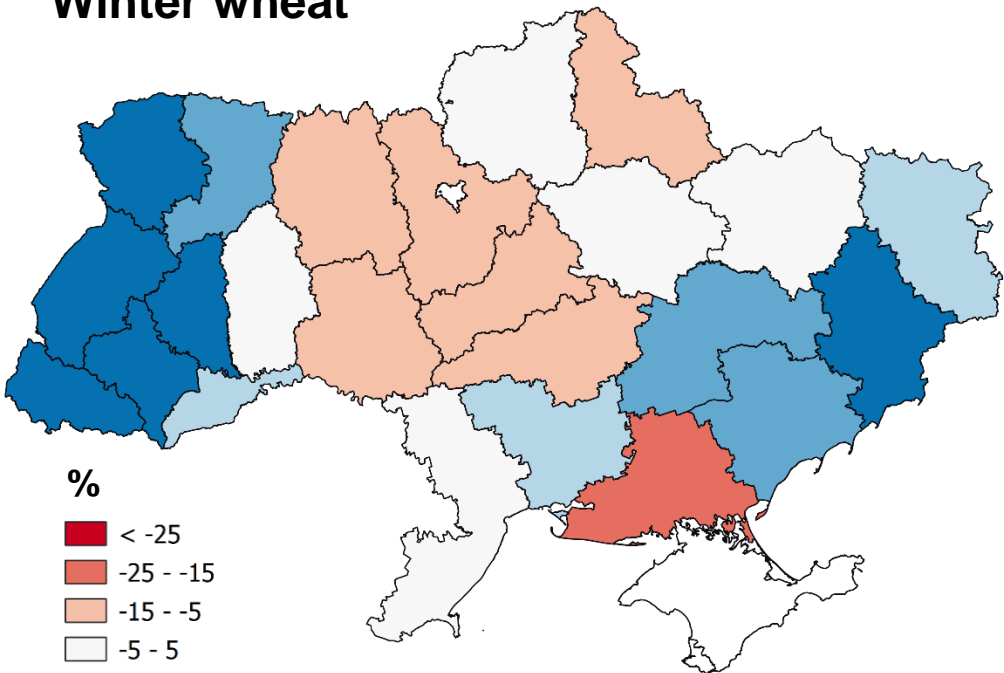
Layers:

- **Yield:** Development of yield forecast in t/ha per forecast date. The light blue error bars are derived for each forecast time from the backtests and show the evolution of the average deviation to later published yield statistics. The backtests include the years 2018 to 2021. Weather forecast uncertainties are also considered in the error bars. The grey line shows the long term average, minimum and maximum yield of the years 2018 to 2021.
- **Yield Deviation:** Predicted yield in relation to the years 2018 to 2021. Positive percentage means more yield expected than average.
- **Production:** Predicted yield multiplied with acreage. The grey line shows the long term average, minimum and maximum production of the years 2018 to 2021.
- **Production Deviation:** Predicted production in relation to the years 2018 to 2021.

The YPSILON service is available on national and oblast level and can be selected through the layers' menu.

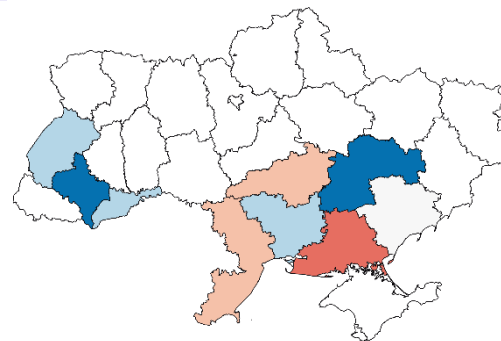


Winter wheat

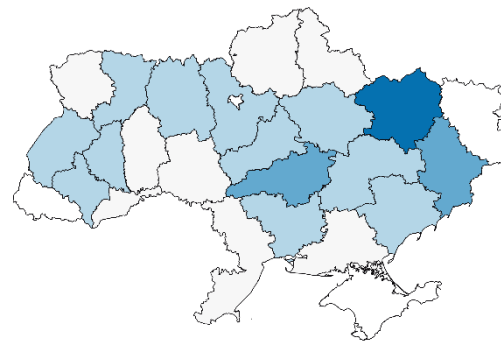


No significant production

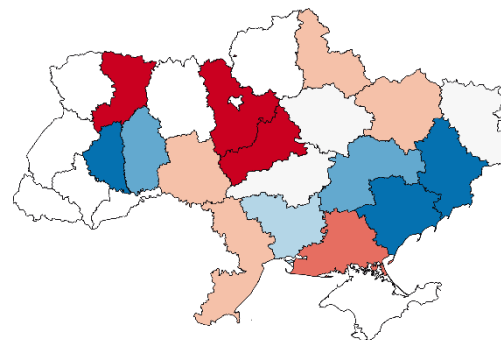
Winter barley



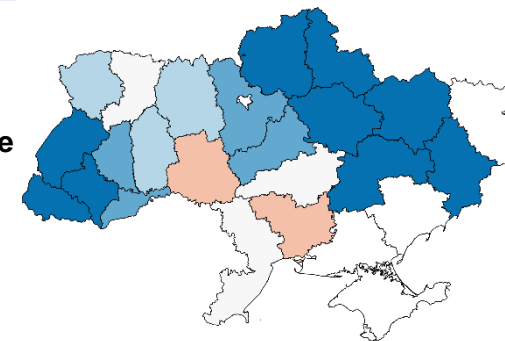
Rapeseed



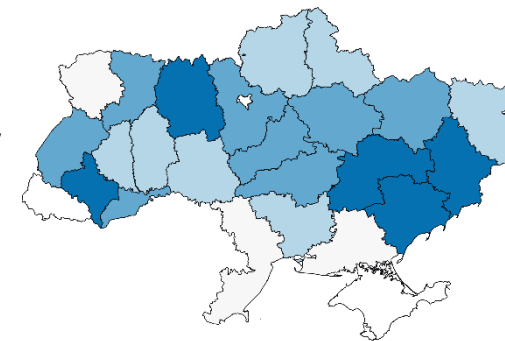
Spring barley



Grain maize



Sunflower



Data can be viewed in the YPSILON Portal



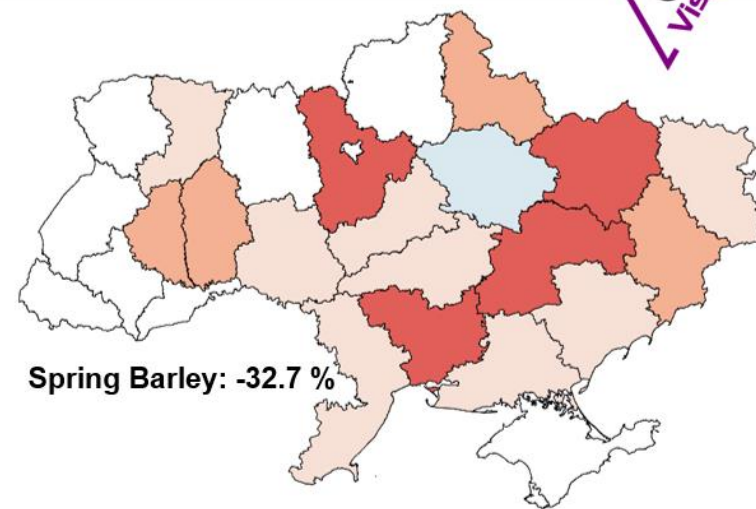
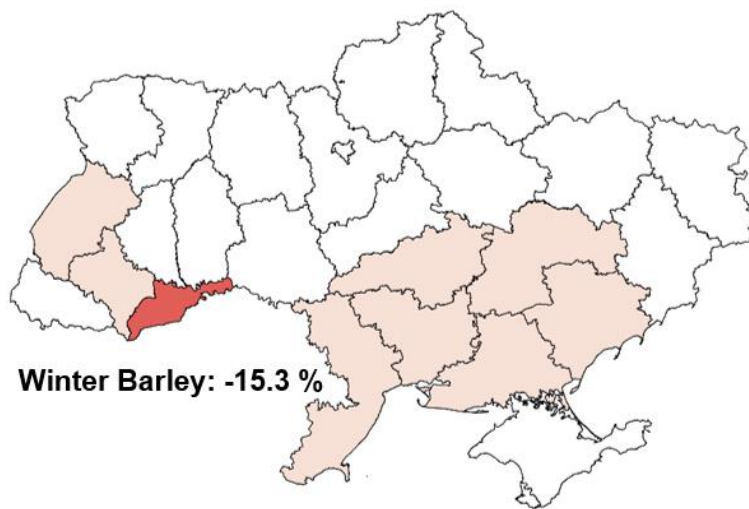
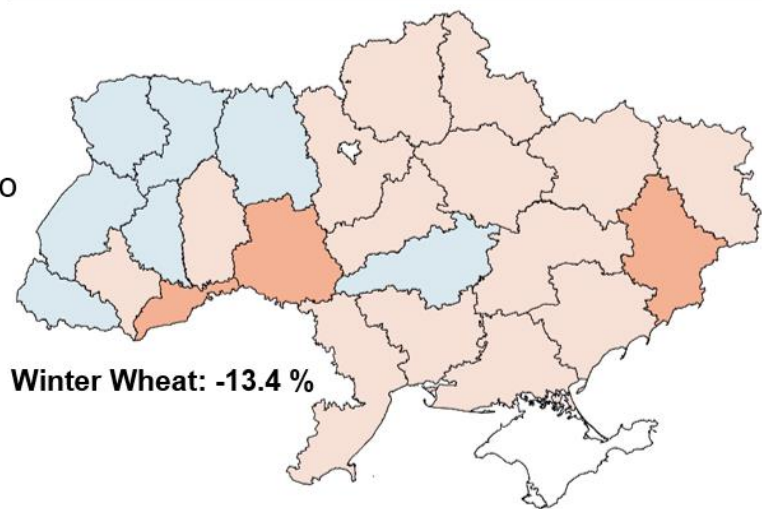
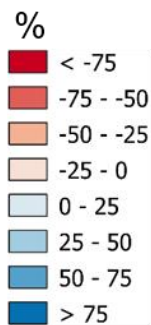
Percentage of change in the area under cultivation* of the simulated crops by VISTA in 2023 compared to the long-term average



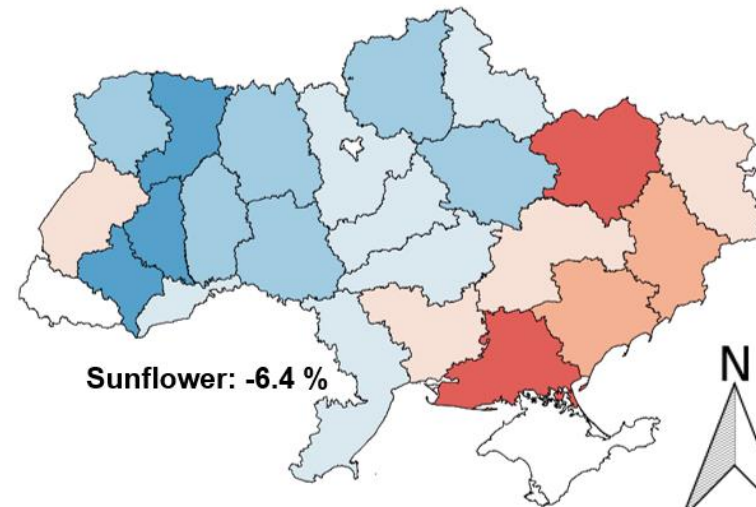
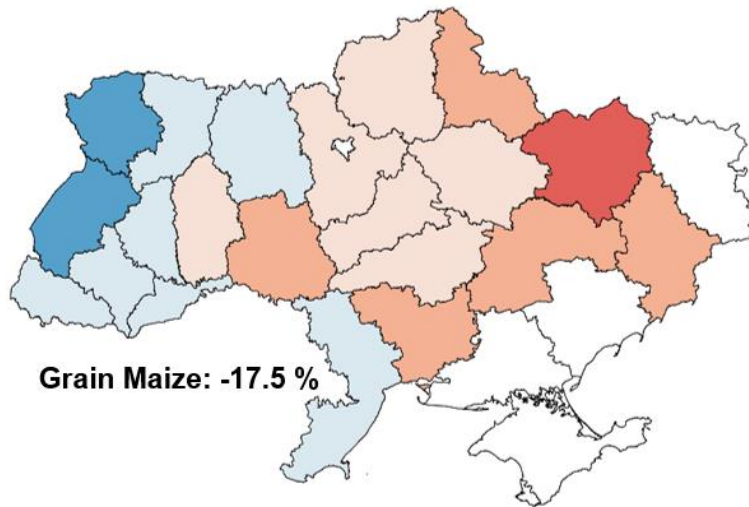
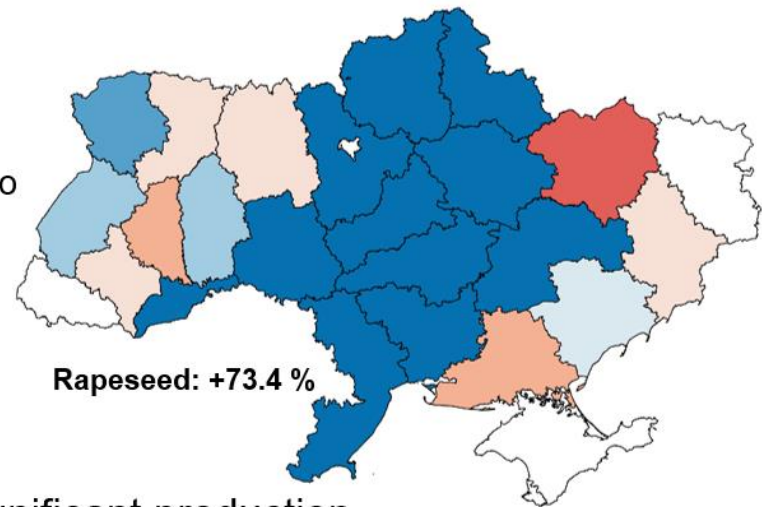
status: 01.11.2023:



Compared to average of 2018 - 2021



Compared to average of 2017 - 2021



No significant production

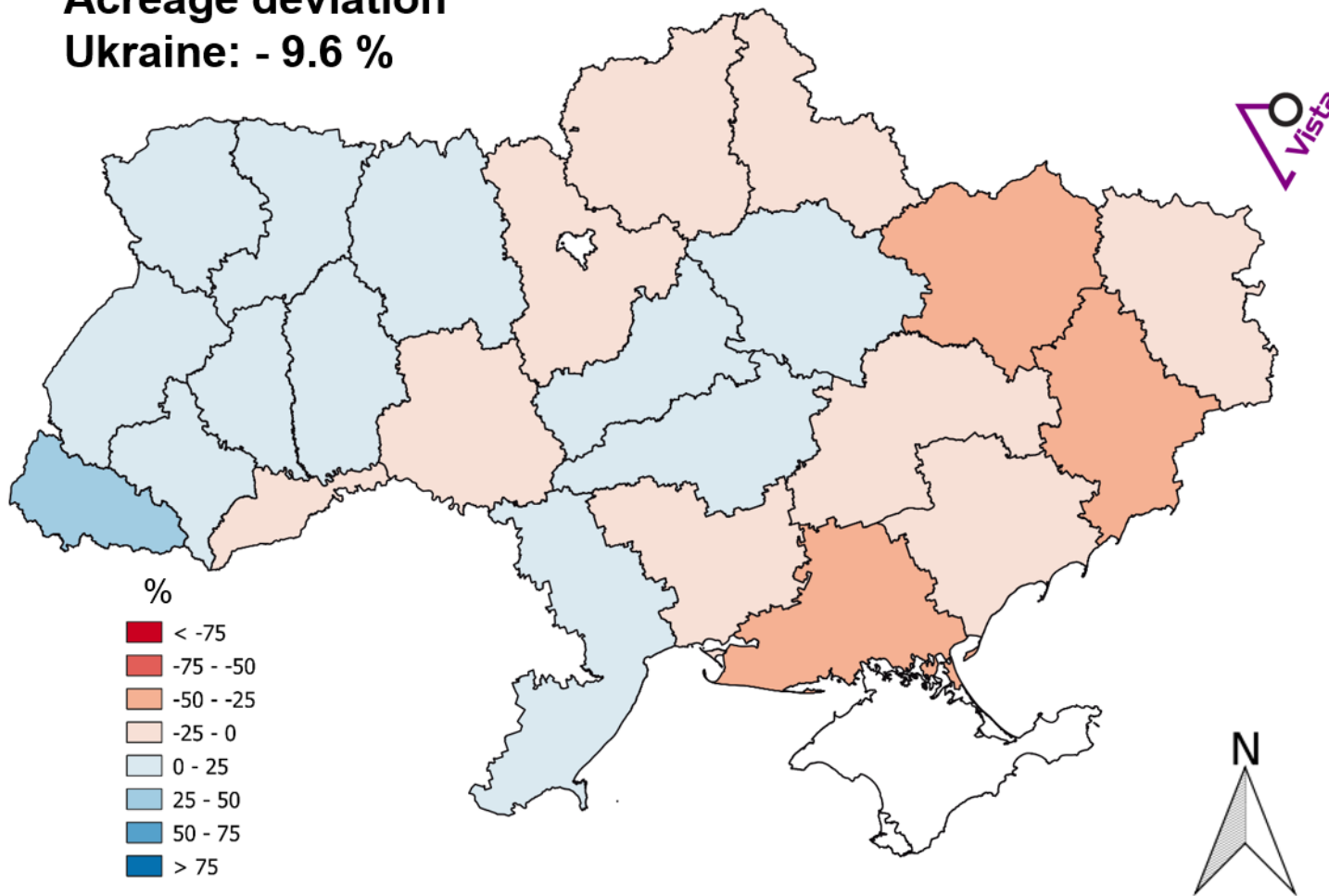
*Based on JRC estimates adjusted the areas affected by the front and dam destruction



Percentage of change in the total area under cultivation* of the simulated crops by VISTA in 2023 compared to the long-term average



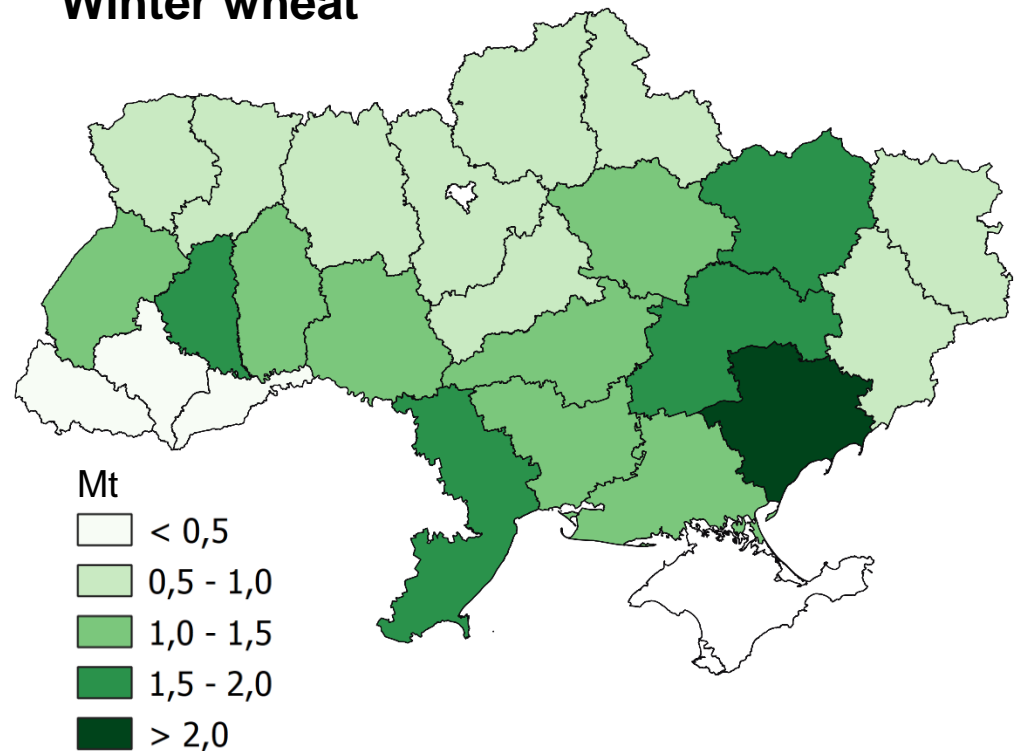
Acreage deviation
Ukraine: - 9.6 %



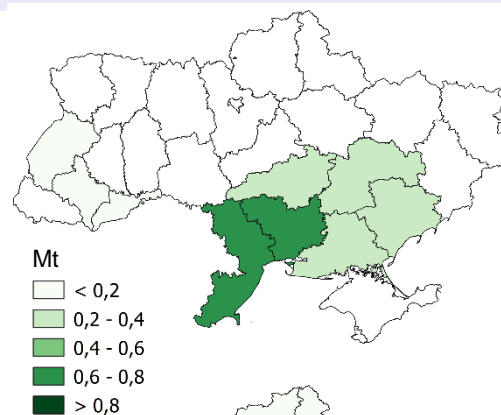
In 2023 overall agricultural area under production was reduced by 9.6%.

*Based on JRC estimates adjusted the areas affected by the front and dam destruction

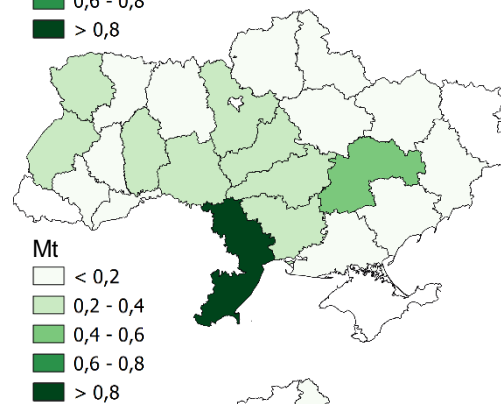
Winter wheat



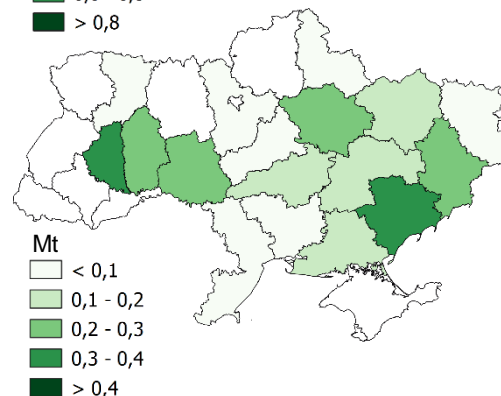
Winter barley



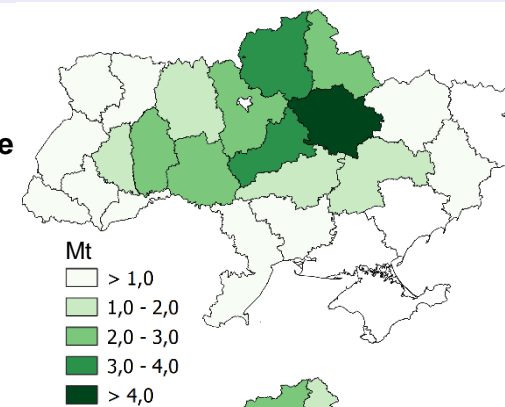
Rapeseed



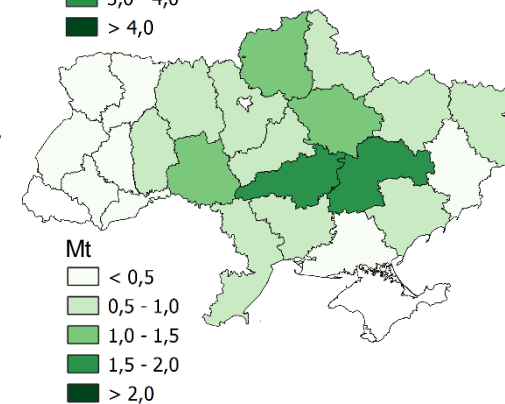
Spring barley



Grain maize



Sunflower

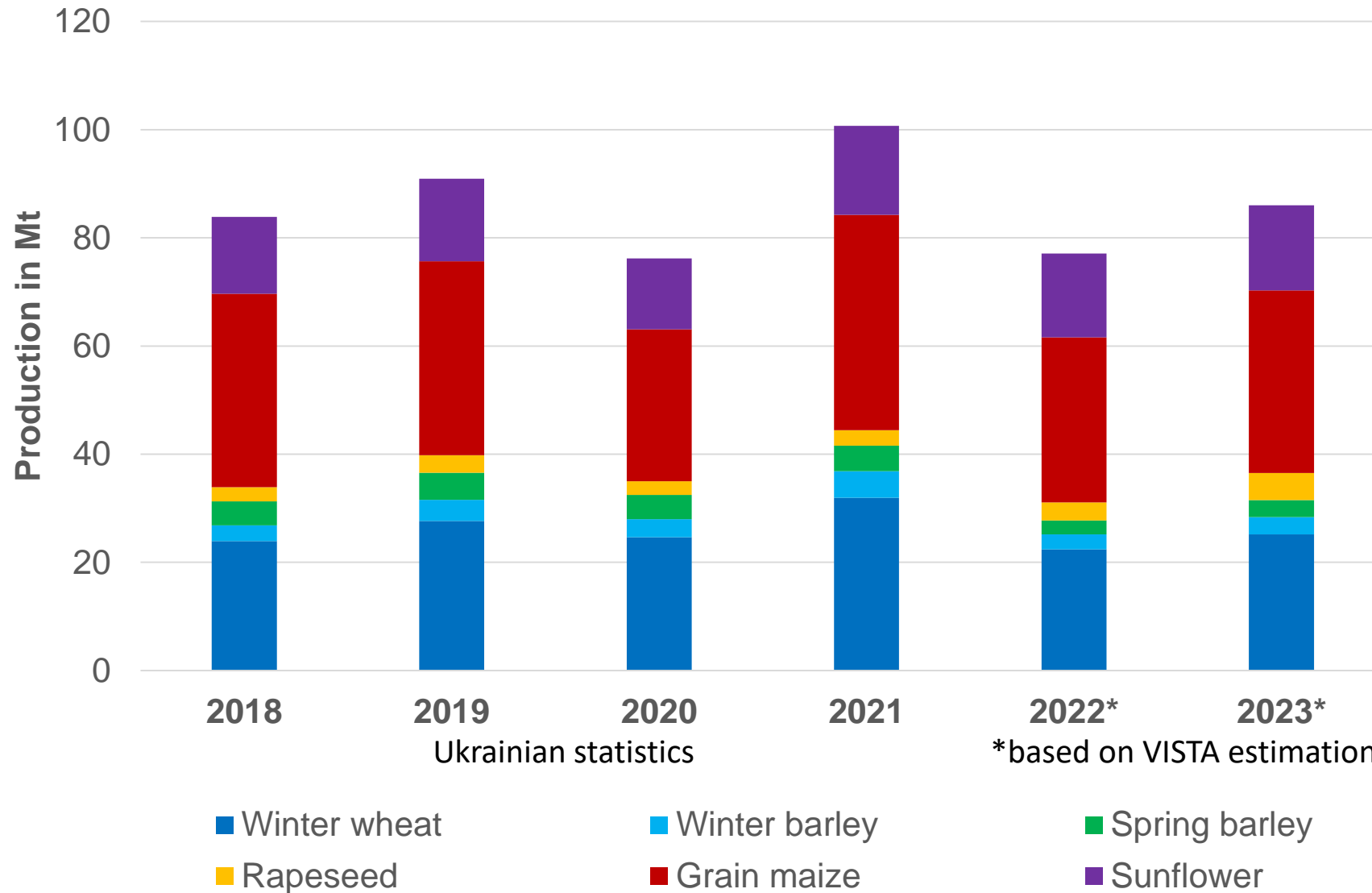


Data set will be delivered to ESA and Ukrainian Ministry of Agriculture





Production in Million tons from 2018 to 2023



Despite war, overall agricultural production in Ukraine 2023 was still in the range of annual variability. A shift to more rapeseed could be monitored.

NASA Harvest: "Owing to good weather, combined with impressive farmer resilience, NASA Harvest's satellite-based analyses have revealed a productive (relatively high-yield) season for the Black Sea region due largely to exceptionally favorable weather. Despite an overall decrease in planted area due to the war, the 2023 season did see an increase in yields and production relative to 2022 for both wheat and sunflower, two of the major export crops in Ukraine."

JRC June: Favourable weather conditions continued during spring, and sustained a positive yield outlook for winter crops in most regions.

JRC September: "Throughout the summer of 2023, Ukraine experienced predominantly favourable weather conditions, with above-average rainfall in July."



VISTA Geowissenschaftliche
FERNKUNDUNG GmbH

www.vista-geo.de

4. Overview of final results and comparison to other forecasts



Heike Bach, Christian Miesgang

Ukraine 2023 Yield and Production Report

(Status 2023-12-02)

Crop	Yield [uncertainty]	Yield deviation	Acreage planted ⁺	Acreage deviation	Production [uncertainty]	Production deviation	Harvested Area Fraction	Production in Frontline areas ⁺⁺
Winter wheat	4.43 t/ha [4.28 - 4.58 t/ha]	+ 8 % *	5.689 Mha	- 13.4 % *	25.19 Mt [24.34 - 26.04 Mt]	- 7 % *	83 %	2.01 Mt [1.94 - 2.08 Mt]
Rapeseed	2.86 t/ha [2.71 - 3.01 t/ha]	+ 7 % **	1.739 Mha	+ 73.4 % **	4.98 Mt [4.71 - 5.24 Mt]	+ 87 % **	90 %	0.11 Mt [0.10 - 0.12 Mt]
Winter barley	3.68 t/ha [3.53 - 3.83 t/ha]	0 % *	0.861 Mha	- 15.3 % *	3.17 Mt [3.04 - 3.30 Mt]	- 16 % *	83 %	0.15 Mt [0.14 - 0.16 Mt]
Spring barley	3.22 t/ha [2.62 - 3.82 t/ha]	+ 1 % *	0.987 Mha	- 32.7 % *	3.17 Mt [2.58 - 3.77 Mt]	- 32 % *	83 %	0.28 Mt [0.23 - 0.33 Mt]
Grain maize	8.57 t/ha [7.97 - 9.17 t/ha]	+ 25 % **	3.939 Mha	- 17.5 % **	33.76 Mt [31.40 - 36.12 Mt]	+ 3 % **	81 %	0.70 Mt [0.65 - 0.75 Mt]
Sunflower	2.73 t/ha [2.43 - 3.03 t/ha]	+ 19 % **	5.771 Mha	- 6.4 % **	15.75 Mt [14.01 - 17.48 Mt]	+ 11 % **	87 %	0.93 Mt [0.83 - 1.03 Mt]

*compared to the yield/production/acreage over the years 2018 - 2021

**compared to the yield/production/acreage over the years 2017 - 2021

⁺ Areas in Million ha (Mha) are based on JRC estimates adjusted the areas affected by the front and dam destruction

⁺⁺ The areas of 10 different oblasts were included



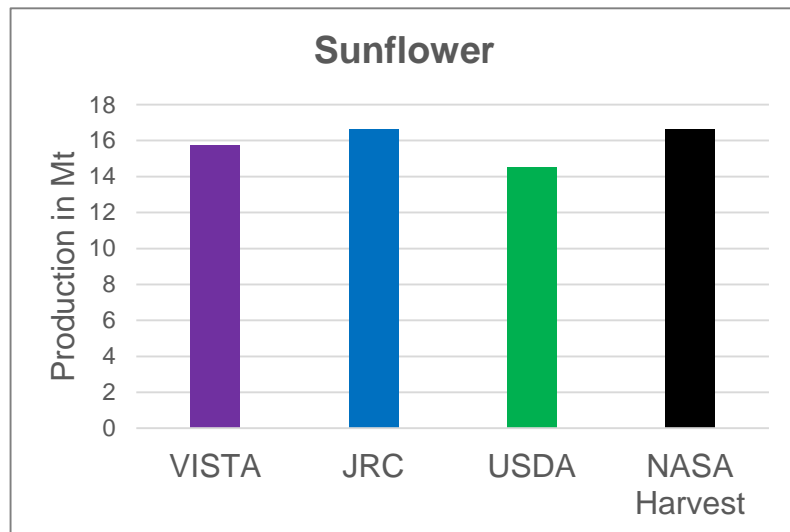
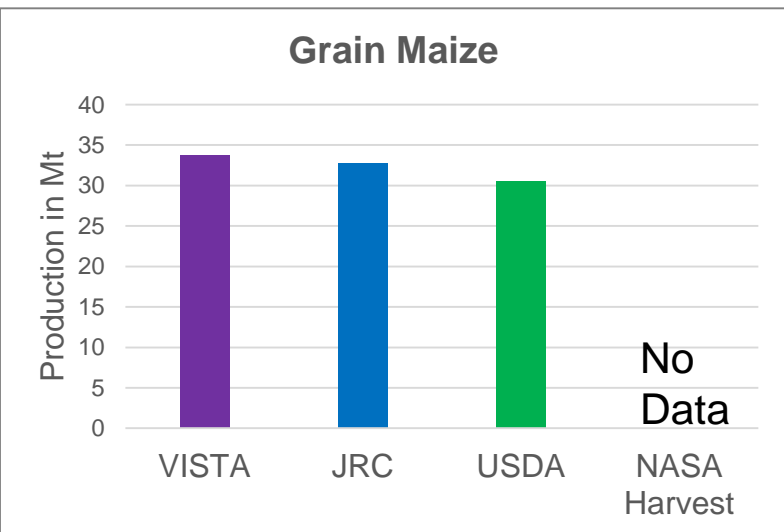
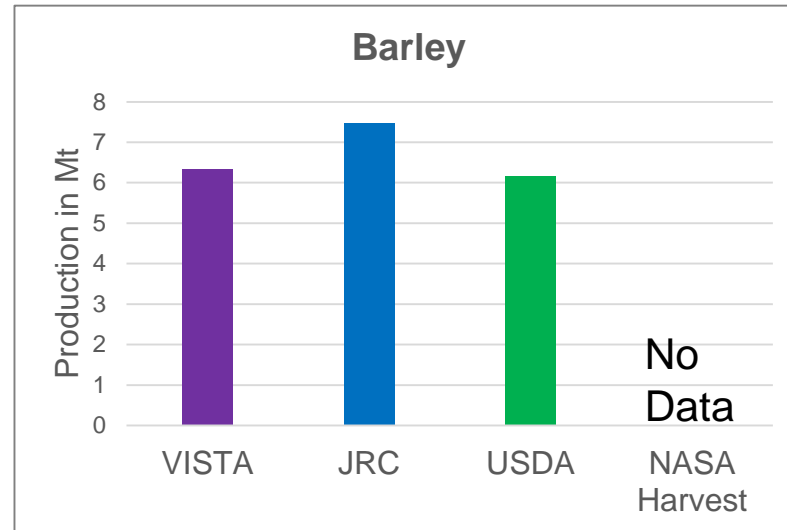
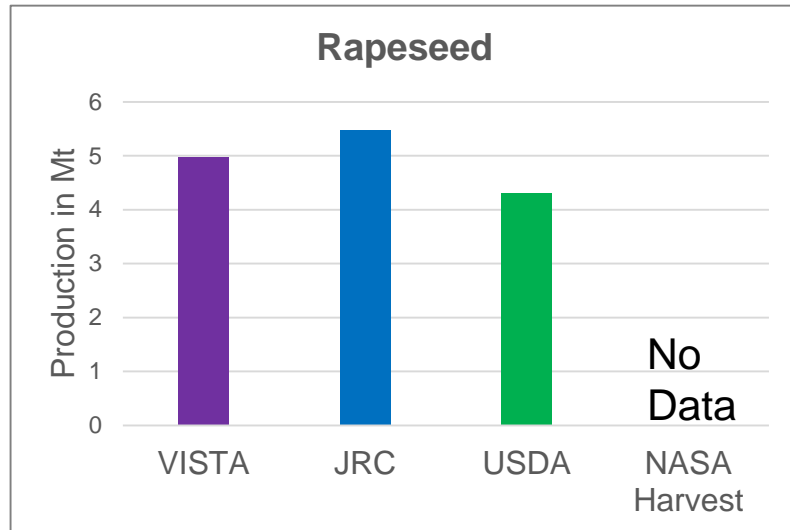
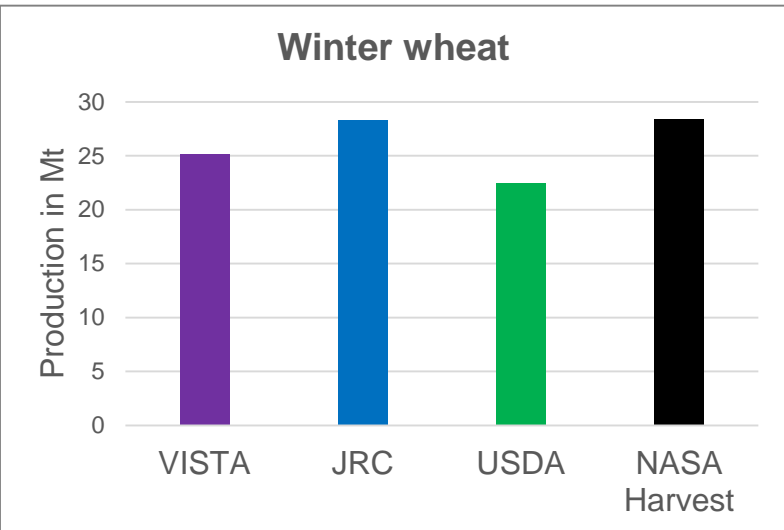
YPSILON results compared to NASA Harvest

(<https://nasaharvest.org/news/farming-amidst-war-satellite-data-reveals-productive-yet-challenging-season-ukraine> Status: 19.12.2023)



Results	NASA Harvest	VISTA
Harvested wheat production	28.43 Mt (winter and spring wheat)	25.19 Mt (+ 2.01 Mt potential production in frontline areas, only winter wheat)
Harvested sunflower production	16.63 Mt	15.75 Mt (+ 0.93 Mt potential production in frontline areas)
Harvested Area wheat	6.22 Mha (winter and spring wheat)	5.69 Mha (only winter wheat)
Percentage of harvested area of wheat	97 % (winter and spring wheat)	83 % (from Sentinel-1, only winter wheat)
Farmland	6.5 – 8.5 % (of total cropland is abandoned)	6.5 % of total cropland could not be used for agriculture in frontline areas In total: Decrease of 9.6 % in acreage compared to long term average of the 6 simulated crop types

Comparison of predicted total production by crop type of various forecasts*



Total Production Ukraine 2023:

VISTA: 86.02 Mt

JRC: 90.67 Mt

USDA: 77.95 Mt

NASA Harvest: not available

*The calculation bases between the individual forecasts are not harmonized. VISTA productions calculated for the whole of Ukraine are excluding Crimea. The methods of the other forecasts may differ.



The project activity allowed the provision of yield and production estimates for 6 crop types with higher level of spatial detail compared to the predictions of other providers. The VISTA YPSILON production forecasts for all crop types at national level are comparable with the results of the other providers.

The impact of war on agriculture in 2023 was even greater than in 2022, despite higher predicted total production due to favorable weather conditions.

- 6.5% of the agricultural area of Ukraine (Crimea excluded) could not be used for agricultural production along the frontline due to adverse effects of hostilities in 2023.
- Overall agricultural area under production for the 6 simulated crop types was reduced by 9.6% compared to the long term average.
- In addition, there are massive problems due to damaged infrastructure such as the destroyed dam and the resulting inability to irrigate large parts of southern Ukraine, which has led to a reduction in the irrigated area in the Kherson oblast of 52%.

We are convinced that our service providing independent, objective and highly detailed information on food production and overall agricultural activity in Ukraine is of high value for international food security. VISTA will offer this service again in 2024 and are looking for supporters.

A satellite with large solar panels is shown in orbit above the Earth's surface, which is covered in clouds and green landmasses. The satellite is gold-colored with a complex structure and two long, dark solar panel arrays extending from it.

Discussion and questions



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