



# World bank project “Supporting Transparent Land Government in Ukraine” as a step towards the digitalization of Ukraine economy and ecology

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„Digital transformation - towards sustainable food value chains in Eurasia”  
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## Objective of the research

- **Identification of preliminary classification of land cover.** Collection in-situ data for land cover development for all Ukraine in 2019.
- **Forming raster map** with layers of land cover categories for Ukraine (Google Earth Engine cloud platform).
- **Estimation** NDVI, irrigated cropland, double crops if available.
- **To analyze** and compare areas of different crops based on satellite data with statistical information.

# Methodology of use of time series of satellite data: crop type mapping

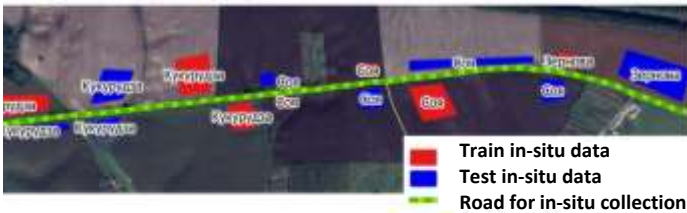


## Input data

Time series satellite data  
(Sentinel-1,2)



In-situ data along the roads



Random Forest in Google  
Earth Engine cloud  
platform

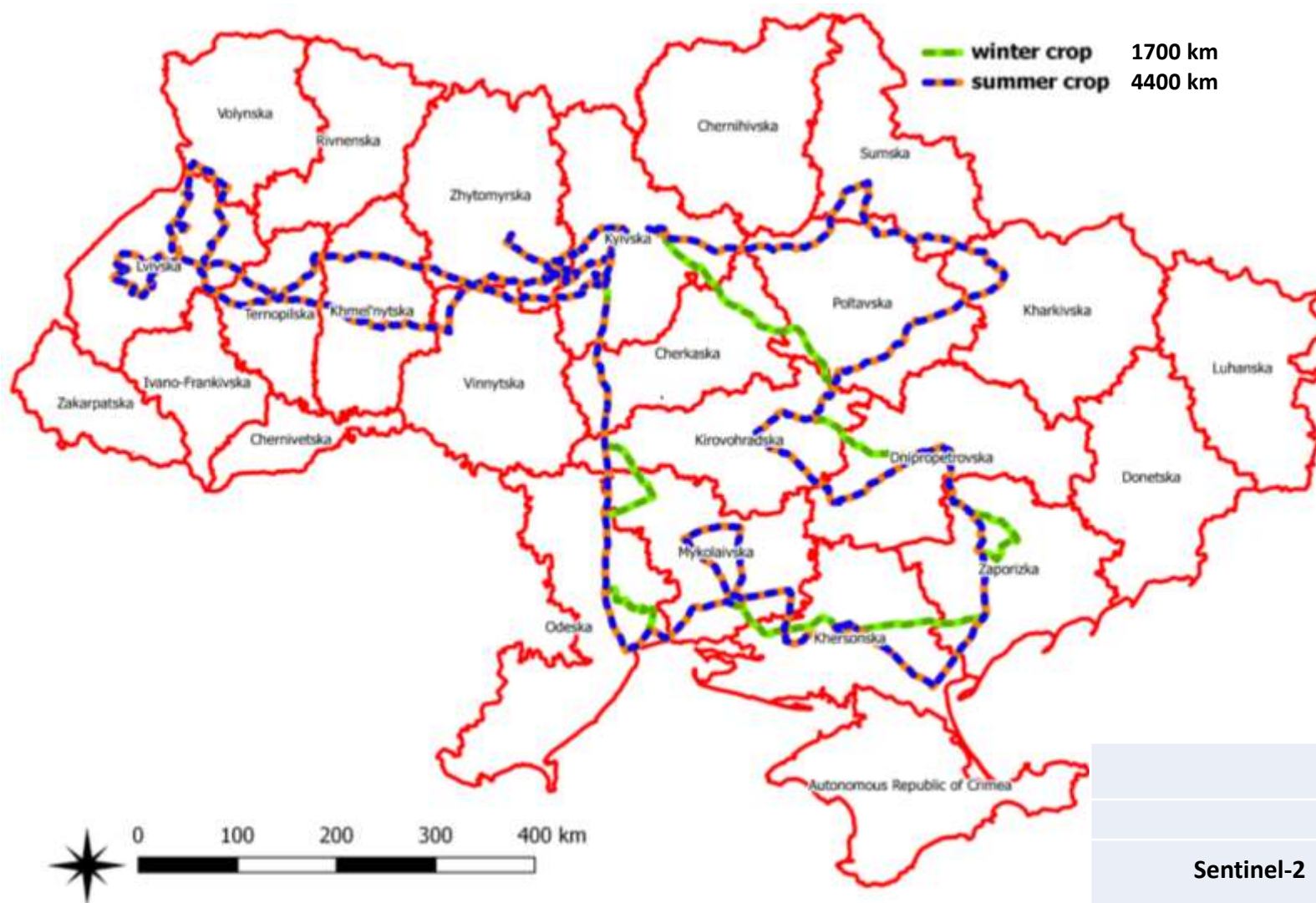


## Classification map





# World Bank project - in-situ data collection in 2019



| Crop Type    | Training data | Testing Data | Total        |
|--------------|---------------|--------------|--------------|
| Artificial   | 222           | 223          | 445          |
| Cereal crops | 1797          | 1776         | 3573         |
| Rapeseed     | 288           | 278          | 566          |
| Buckwheat    | 13            | 10           | 23           |
| Maize        | 576           | 565          | 1141         |
| Sugar beet   | 36            | 29           | 65           |
| Sunflower    | 690           | 681          | 1371         |
| Soy          | 373           | 367          | 740          |
| Other crops  | 113           | 108          | 221          |
| Forest       | 223           | 224          | 447          |
| Grassland    | 888           | 866          | 1754         |
| Bare land    | 135           | 115          | 250          |
| Water        | 351           | 327          | 678          |
| Wetland      | 107           | 114          | 221          |
| Peas         | 37            | 34           | 71           |
| Alfalfa      | 45            | 34           | 79           |
| Orchards     | 191           | 176          | 367          |
| Grape        | 231           | 224          | 455          |
| <b>Total</b> | <b>6316</b>   | <b>6151</b>  | <b>12467</b> |

WB Project "Supporting Transparent Land Governance in Ukraine"

## Satellite data

Sentinel-1: 2019-04-01 - 2019-10-15

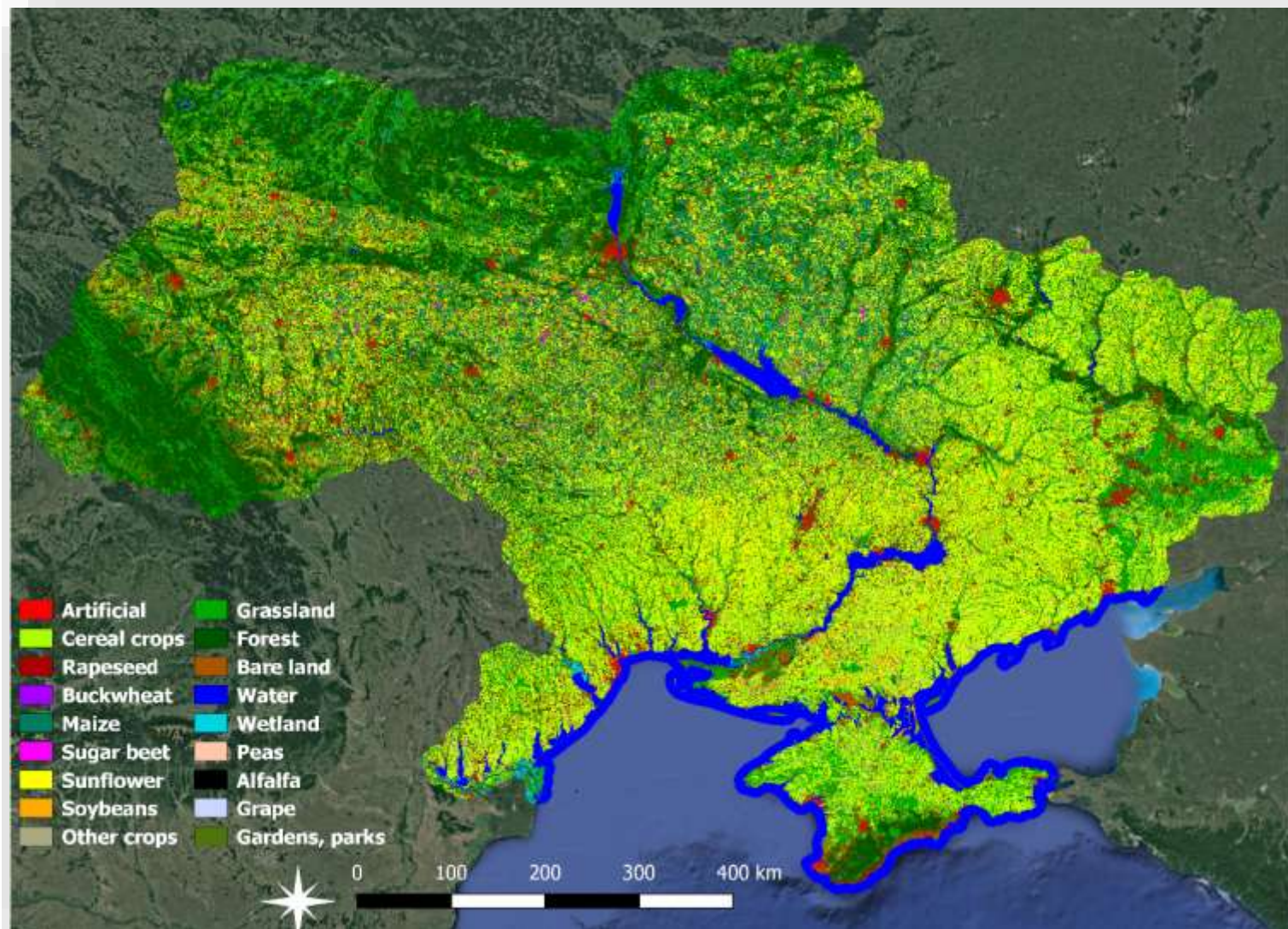
Sentinel-2  
Composites (GEE)

01.04.2019 - 31.05.2019; 01.05.2019 - 25.06.2019;  
25.06.2019 - 22.08.2019; 22.08.2019 - 20.09.2019;  
01.09.2019 - 15.10.2019

Grids of satellite (EOS)

2019-04-01 - 2019-10-15

# Classification map for Ukraine, 2019



| Obtained accuracy | GEE  |      |      |
|-------------------|------|------|------|
|                   | UA   | PA   | F1   |
| Artificial        | 57,1 | 92,5 | 70,6 |
| Cereal crops      | 96,3 | 99,3 | 97,8 |
| Rapeseed          | 98,1 | 99,7 | 98,9 |
| Buckwheat         | 100  | 13,7 | 24   |
| Maize             | 95,7 | 98,1 | 96,9 |
| Sugar beet        | 93,1 | 80,9 | 86,6 |
| Sunflower         | 97,4 | 99   | 98,2 |
| Soy               | 90,1 | 84   | 86,9 |
| Other crops       | 43,3 | 28,5 | 34,4 |
| Forest            | 83,6 | 99,8 | 91   |
| Grassland         | 71,4 | 92,4 | 80,5 |
| Bare land         | 76,1 | 55,2 | 64   |
| Water             | 100  | 98,4 | 99,2 |
| Wetland           | 92,3 | 48,4 | 63,5 |
| Peas              | 98,5 | 52,7 | 68,6 |
| Alfalfa           | 97,2 | 52,9 | 68,5 |
| Gardens, parks    | 76,2 | 48,1 | 59   |
| Grape             | 97   | 30,6 | 46,6 |
| Overall accuracy  | 94,8 |      |      |

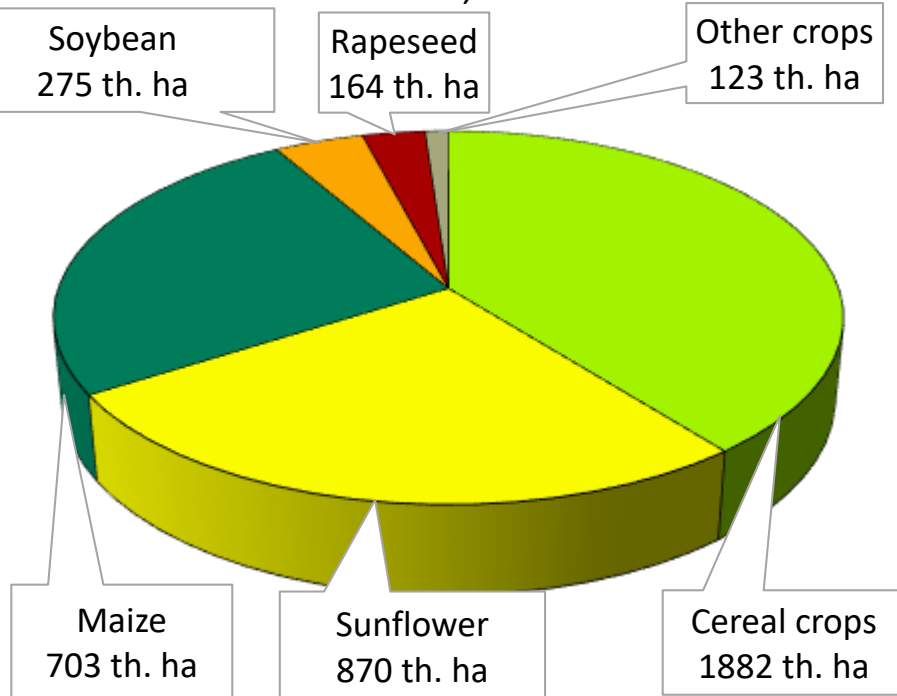


# The results of the project are included in the work of the Ministry of Economy and presented by the Minister



- The classification map is a significant contribution to the initiative GEO Global Agricultural Monitoring
- Satellite data and artificial intelligence using to combat the shadow land market

Crop distribution on **unregistered land** in Ukraine, 2019

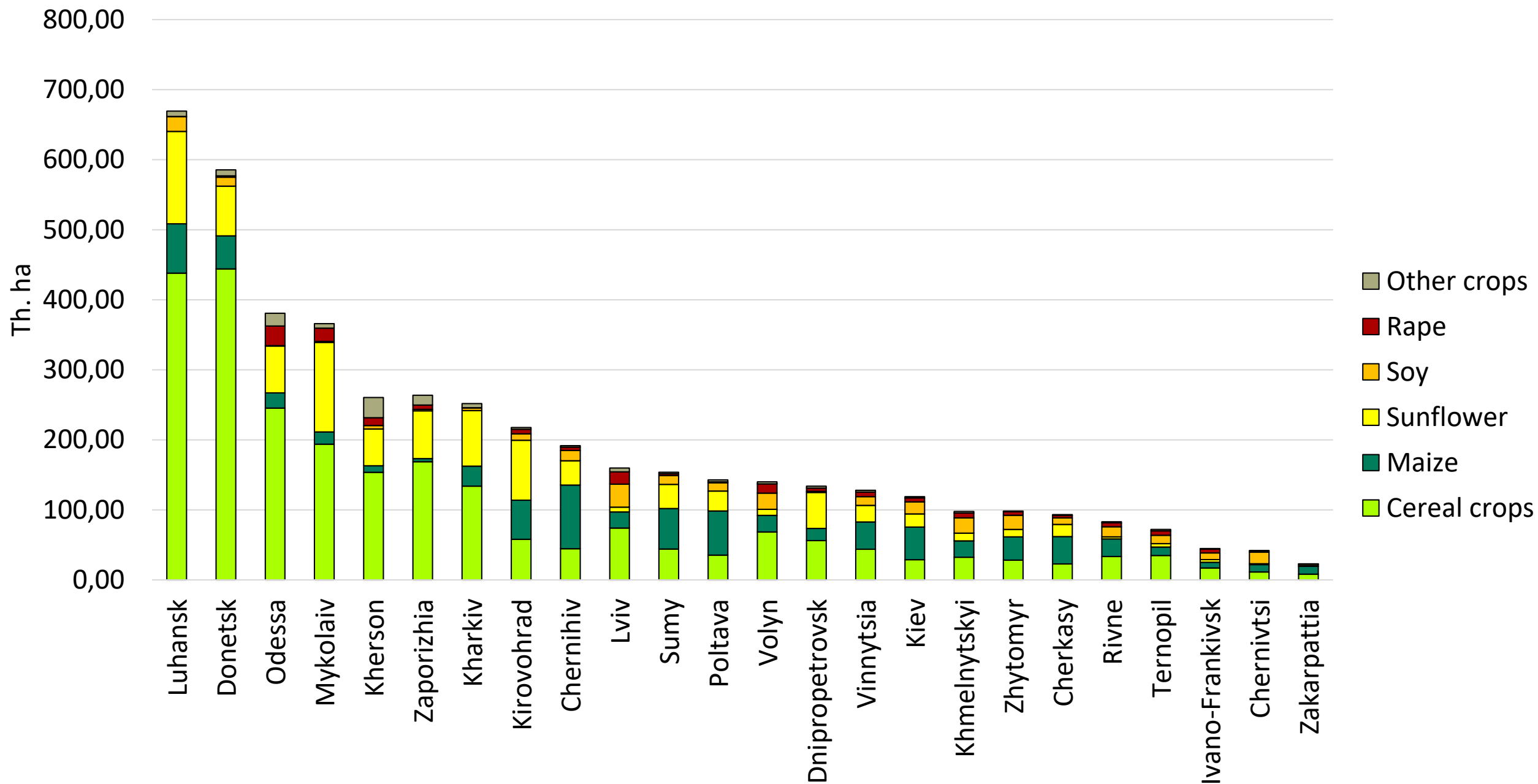


Link to the portal <https://map.geoportalua.com/worldbank/>

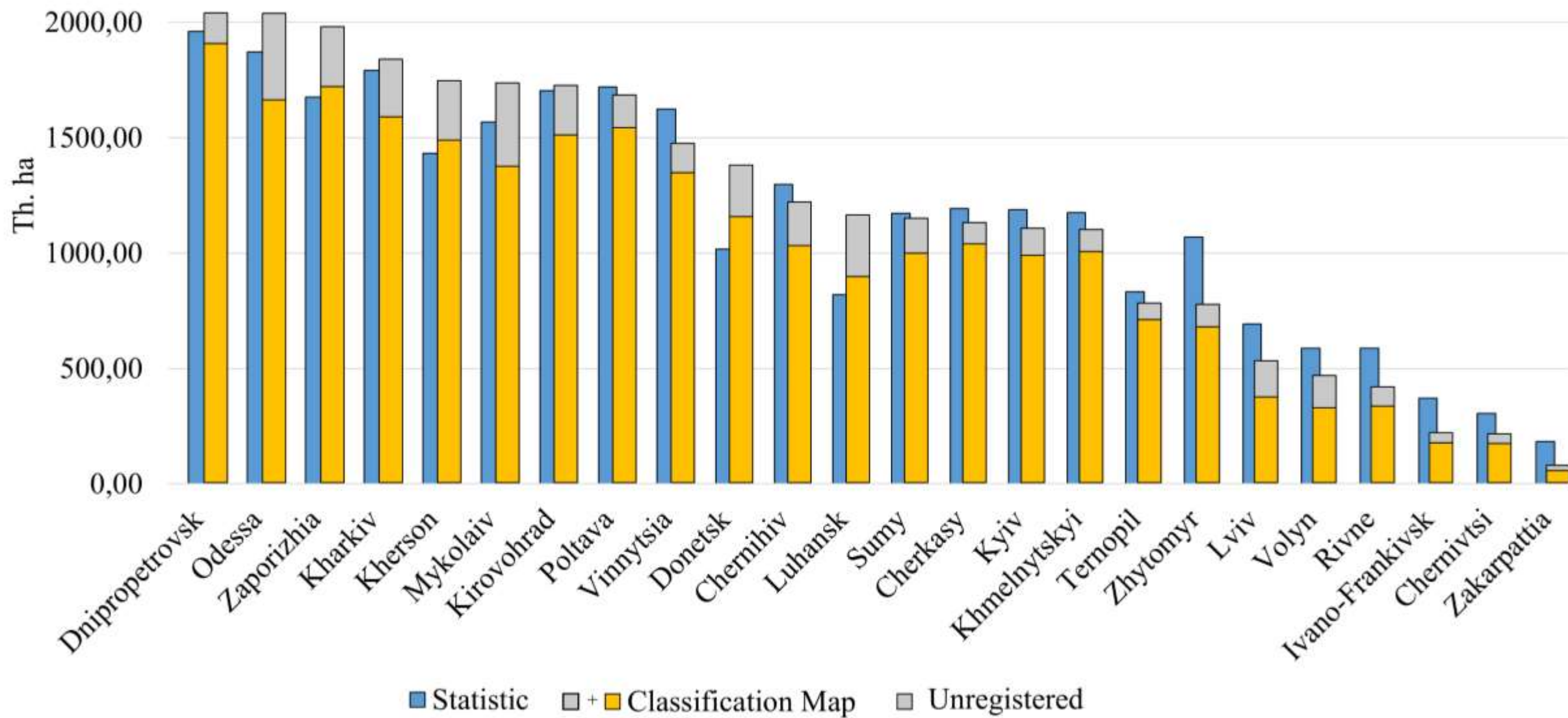
Speech by Timothy Milovanov <https://www.facebook.com/100004775745586/videos/1522471084588735/>

Spring and winter classification maps on a public cadastral map <https://newmap.land.gov.ua/>

# Area of agricultural crops on unregistered lands in the territory of Ukraine, 2019

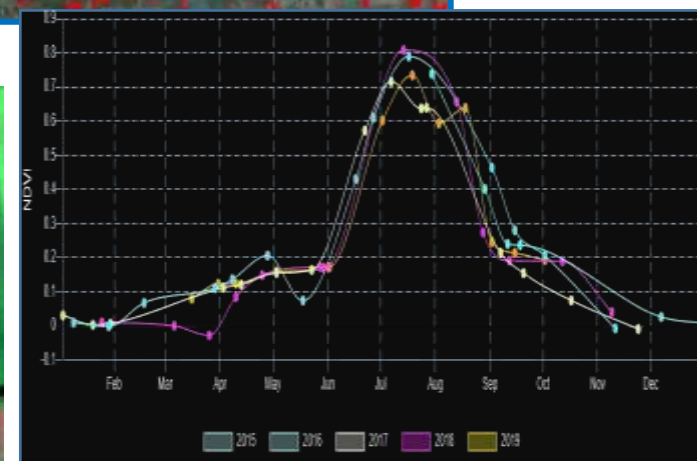
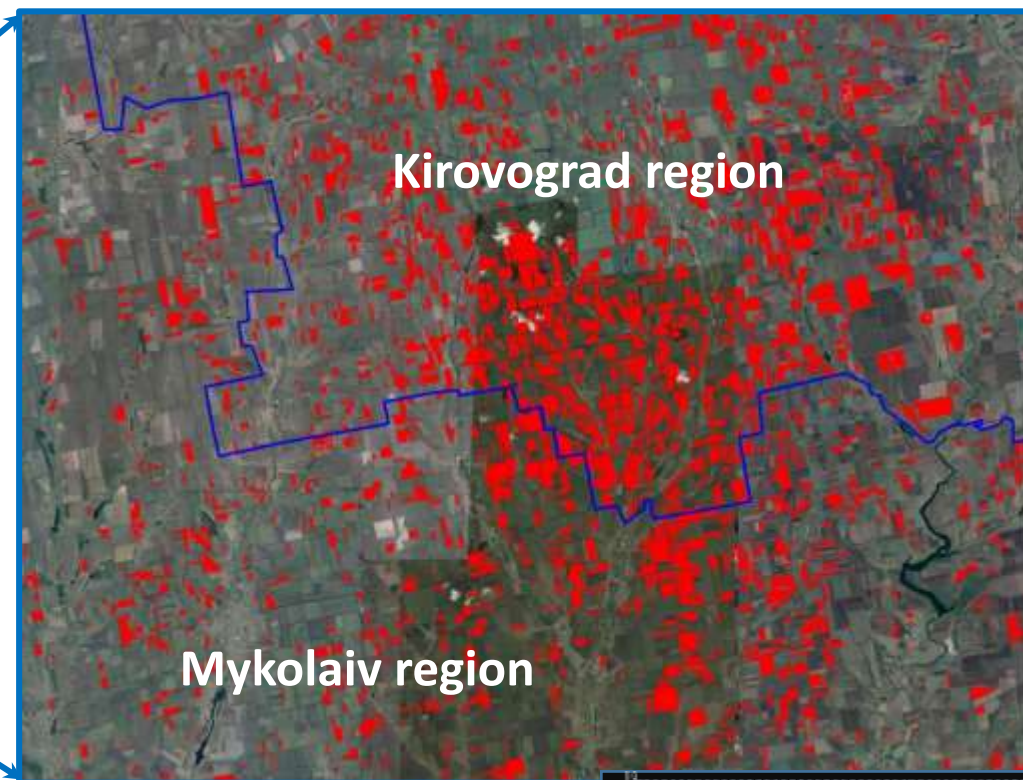
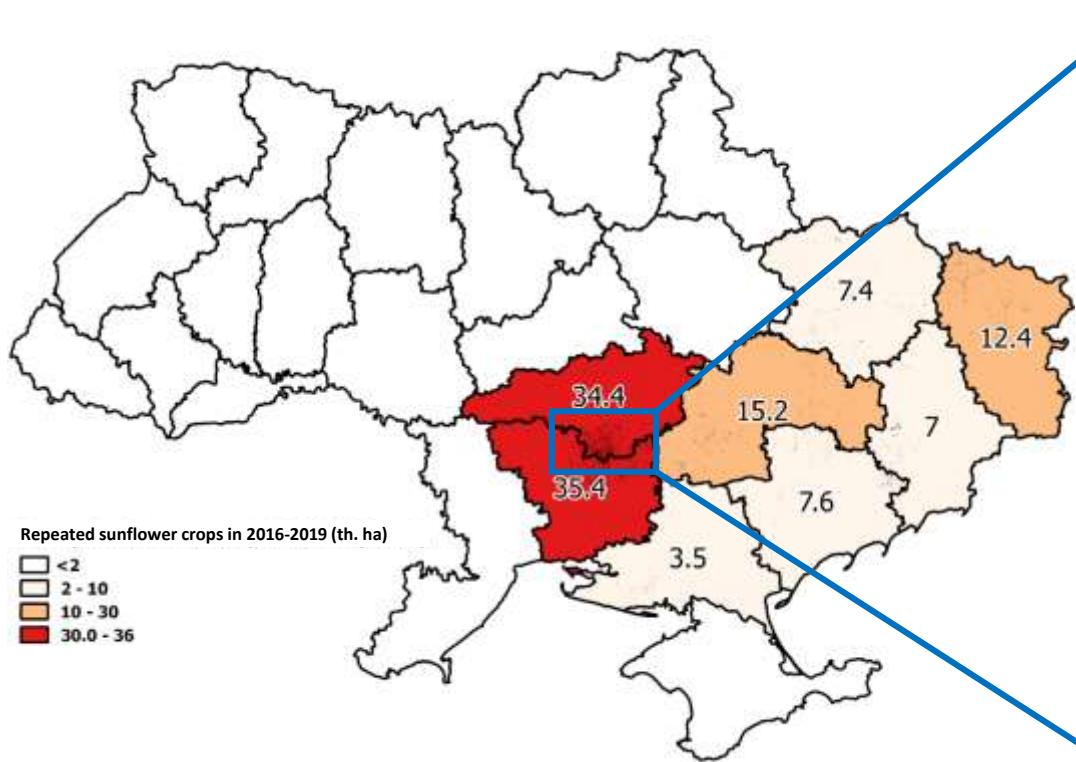


# Comparison of area in unregistered lands with total crop area by satellite data and statistics, 2019





# Monitoring of repeated sunflower crops for 4 years (2016-2019)





# Monitoring of two crops per season

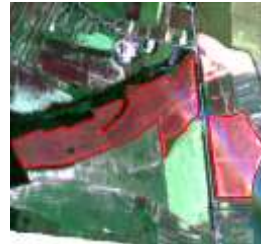


4 April

3 June

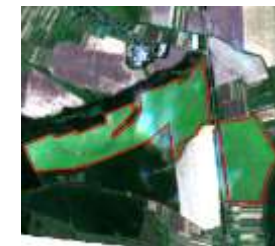
9 May

26 June



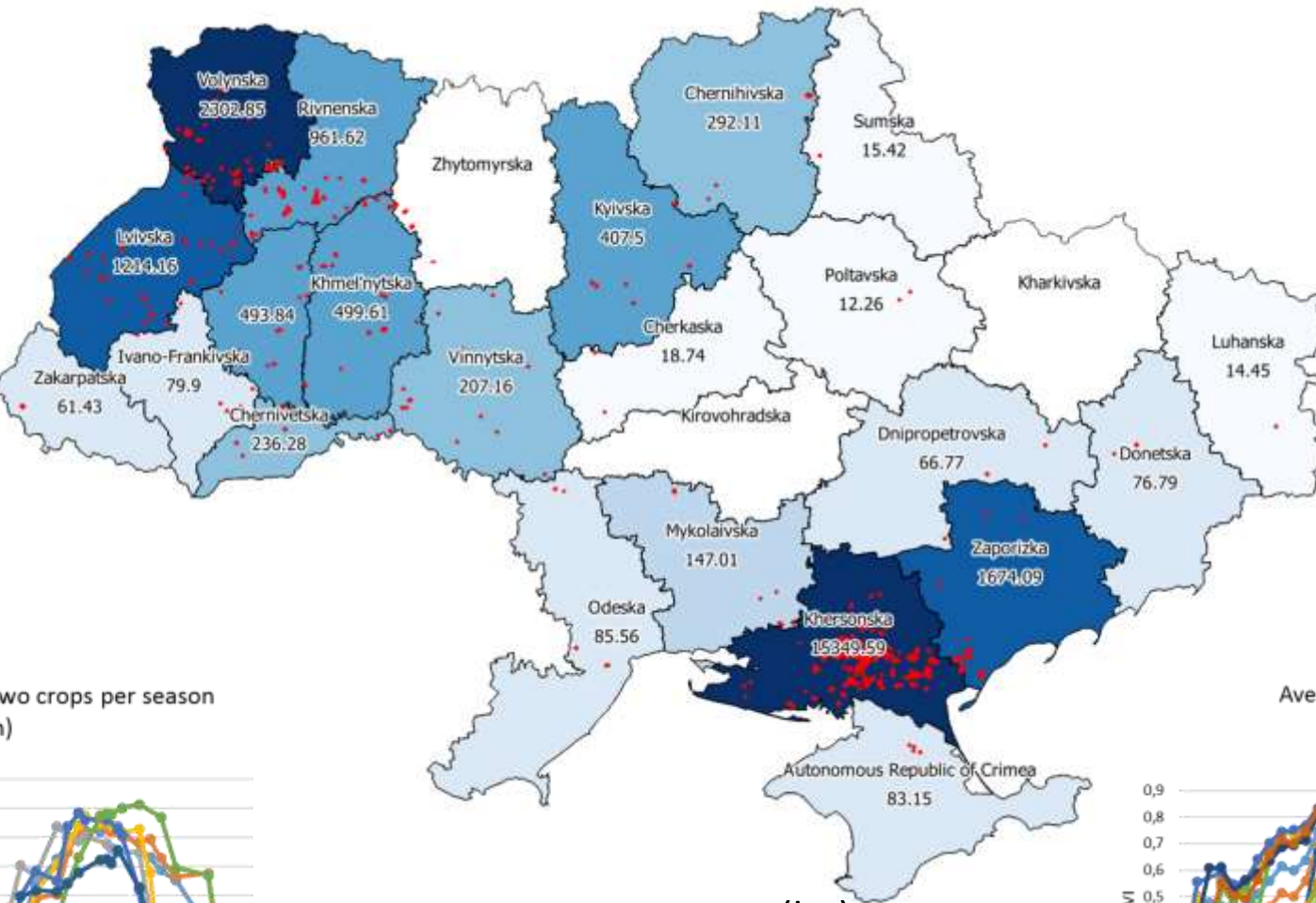
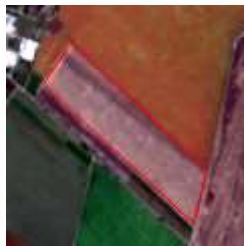
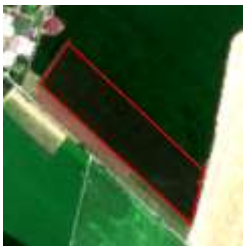
28 July

16 October

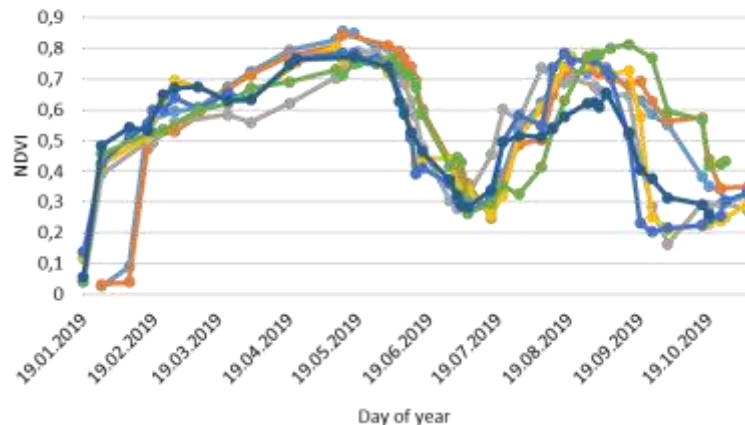


28 July

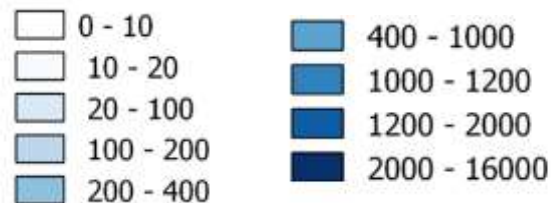
11 September



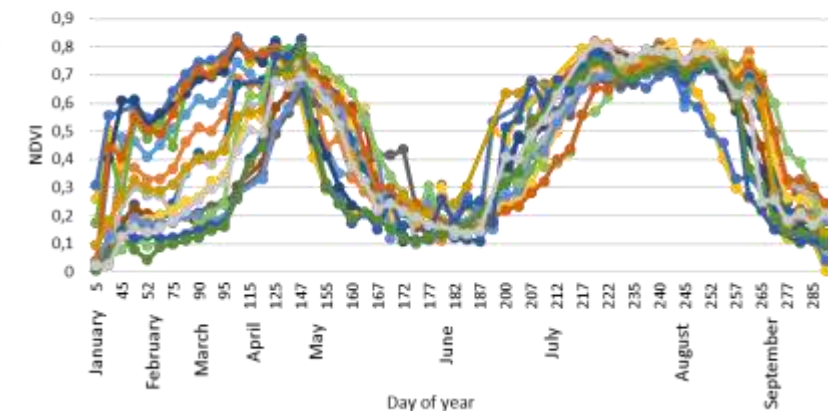
Average NDVI for fields with two crops per season (Lviv region)



Two crops per season (ha)



Average NDVI for fields with two crops per season (Kherson region)

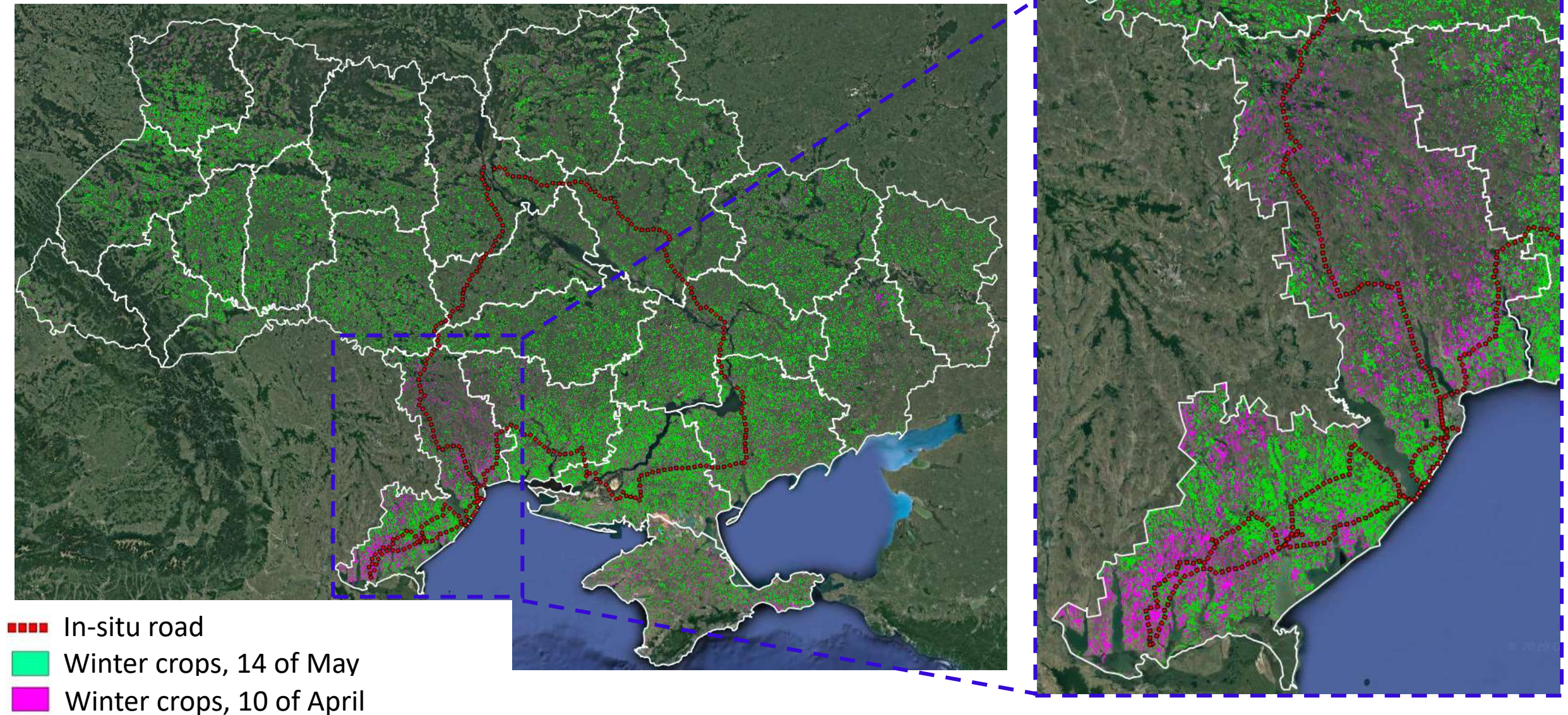




## Winter crop maps (10 of April, 14 of May 2020) based on satellite data

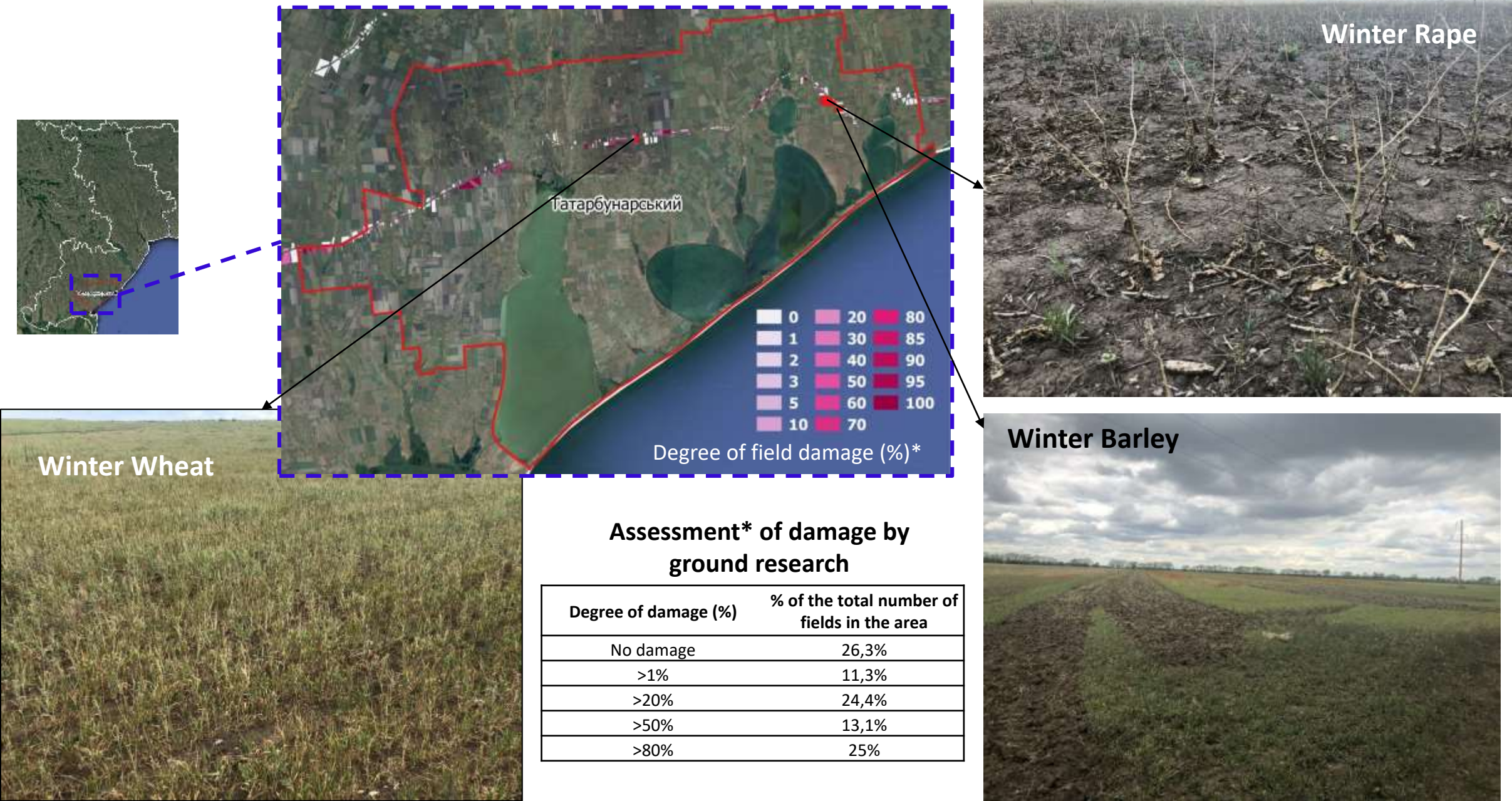
Overall accuracy of products are more than 85% based on in-situ data.  
The winter crop maps received without in-situ data.

The area most affected by the drought  
is Odessa region





# Damage to winter crops in Tatarbunary district of Odessa region, 2020

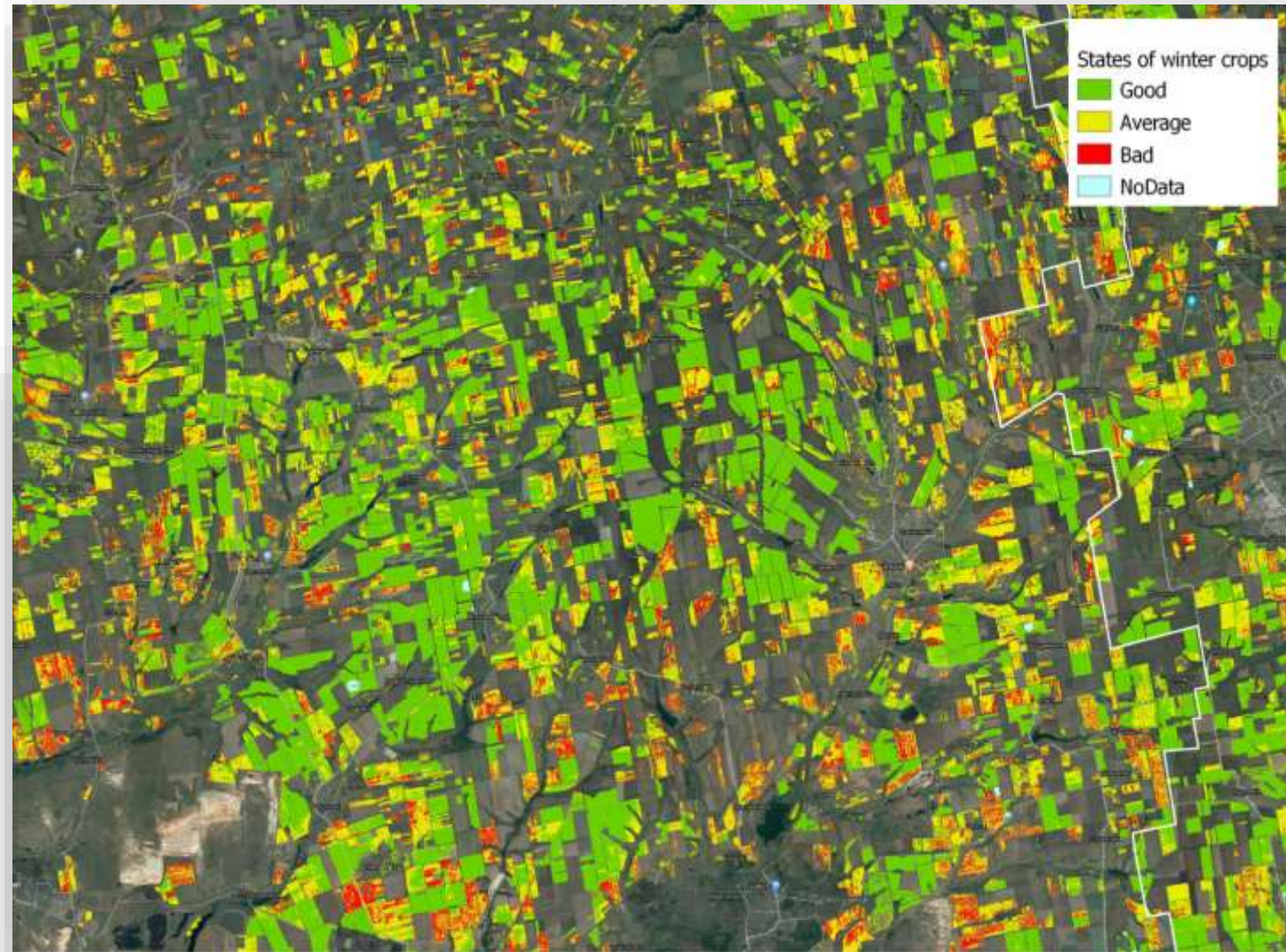
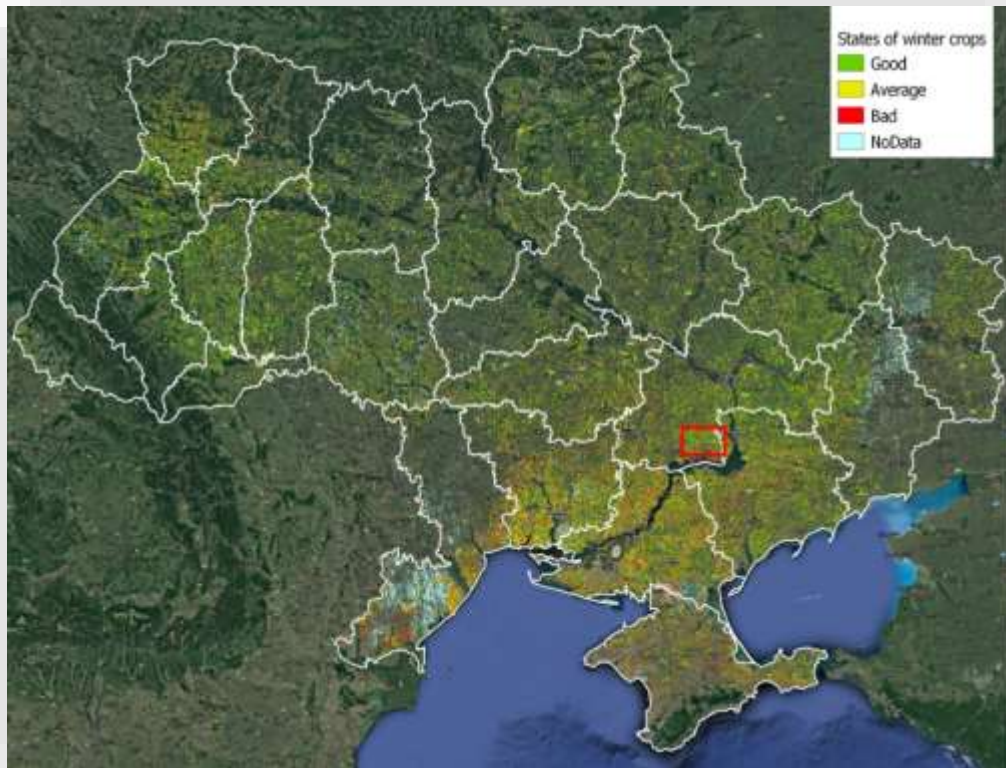


\*The degree of field damage was assessed directly on the field. This value is a subjective indicator



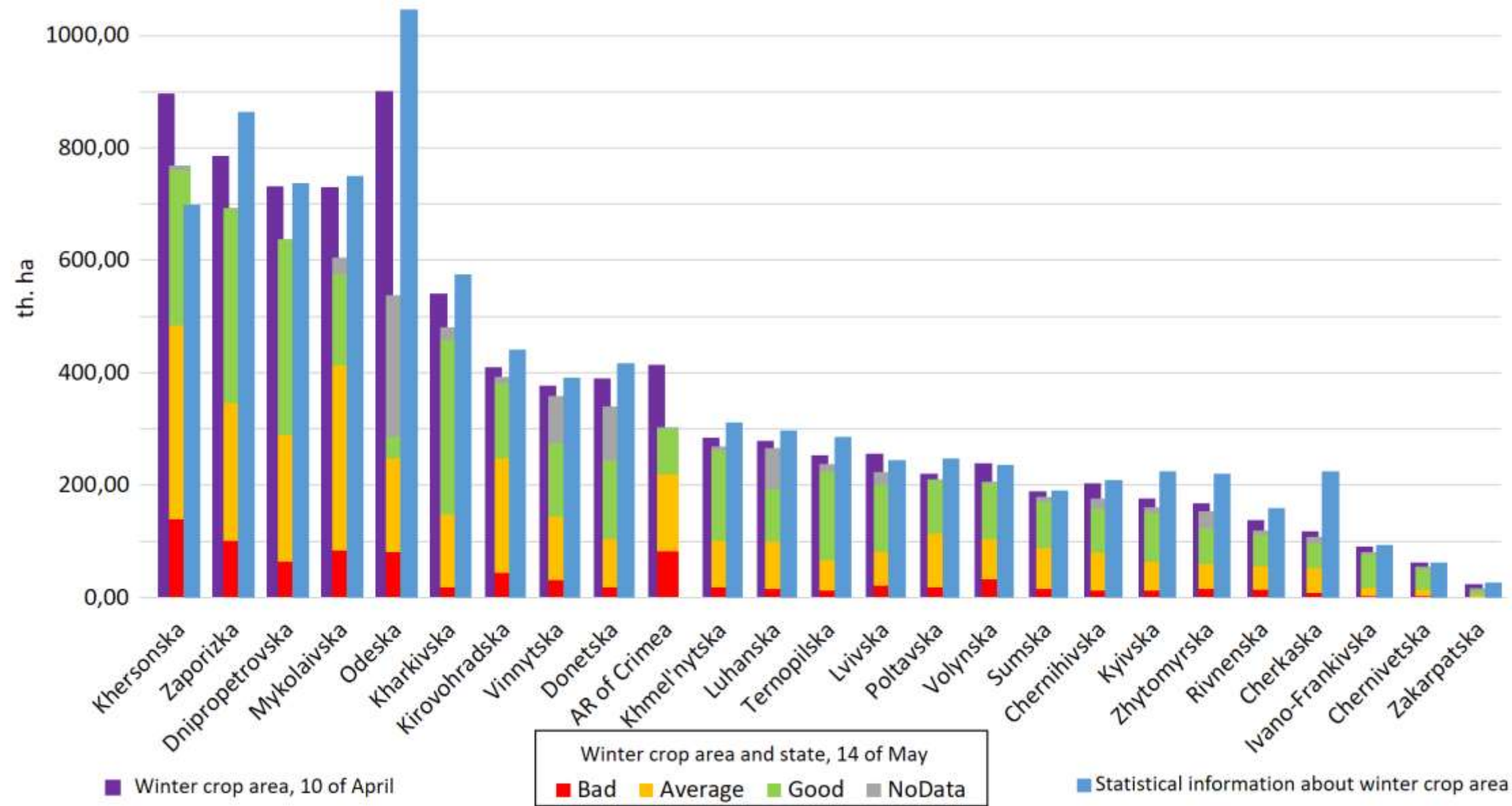
## The winter crop state map based on optical satellite data, 14 of May

- About 13% of winter crops in Ukraine are in poor condition, 40% - in a depressed state, and 47% are in good condition.
- Territories where winter crops are in poor condition - the southern regions of Ukraine





Comparison of winter crops area as of April 10 and May 14, 2020 according to satellite data for the whole territory of Ukraine



Comparison of winter crops areas as of May 14, 2020 with areas of winter crops in 2019

