

Collaboration of Space Research Institute NASU-SSAU with EC JRC on satellite monitoring for food security: background and prospects

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Context of cooperation - GEO related projects



- **GEOGLAM**

GEO Global Agricultural Monitoring Initiative



- **JECAM**

Joint Experiment on Crop Assessment and Monitoring

JECAM

- **SIGMA**

SIGMA – FP7 Project “Stimulating Innovation for Global Monitoring of Agriculture”

SIGMA I

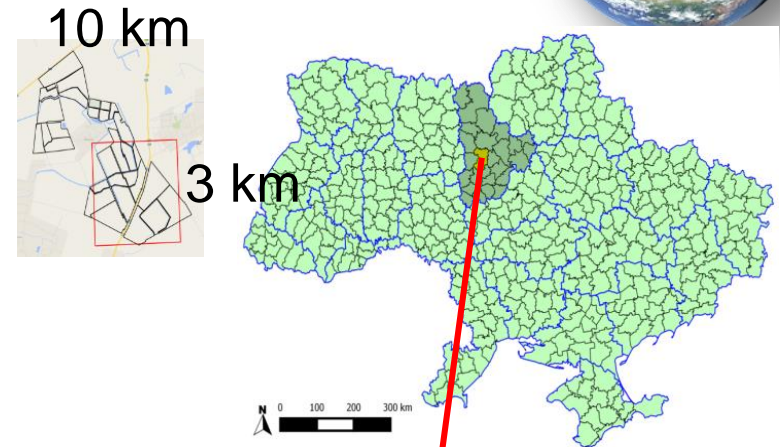
- **ERA-PLANET**

Horizon 2020 project on European Research Area in Earth Observations

JECAM-Ukraine site description



- **Location:** Ukraine (Kyiv oblast with area 28,000 km²; intensive observation sub-site of 25x15 km²). Centroid: lat: 50.35° N, long: 30.71° E
- Intensive agriculture area. Main crop types: **winter wheat, winter rapeseed, spring barley, maize, soybeans, sunflower, sugar beet, and vegetables**
- Field size: **from 30 to 250 ha**
- Crop calendar: **Winter: September – July; Summer: April – October**
- Cloud coverage can be very frequent during the growing season
- Topography: mostly flat, slope: 0% to 2%
- Soils: different kinds of **chernozems**
- Soil drainage is ranging from poor to well-drained. Irrigation infrastructure is limited
- Climate and weather: **humid continental**



Kyiv oblast & Vasylkiv district

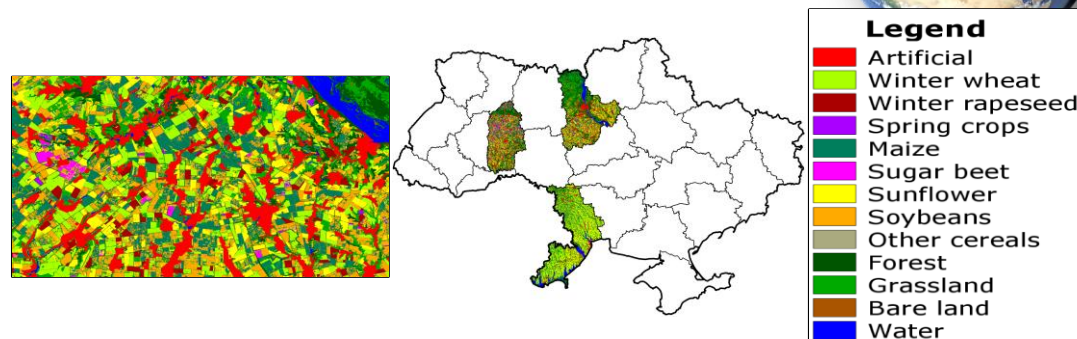


Map of intensive observation sub-site

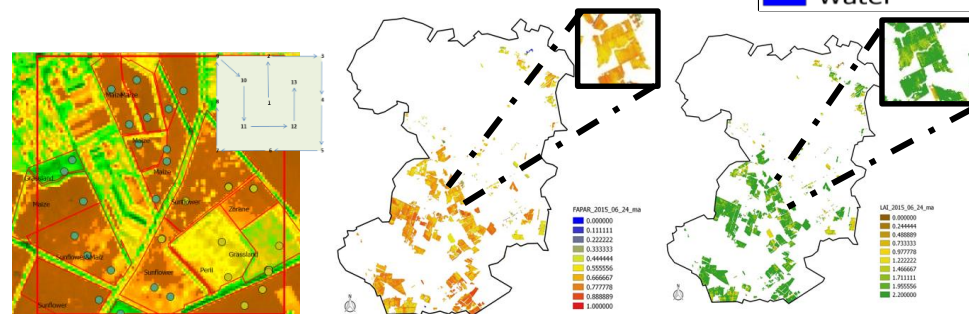
Main directions of cooperation with JRC



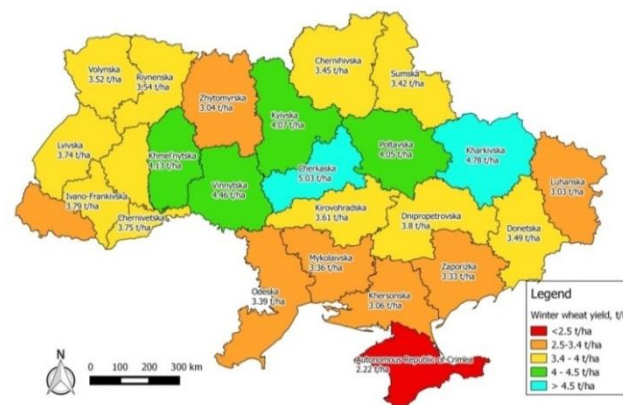
Crop classification & area assessment



Biophysical parameters estimation



Crop yield forecasting



NASU-JRC Information day, 14.09.2016, Kiev, Ukraine

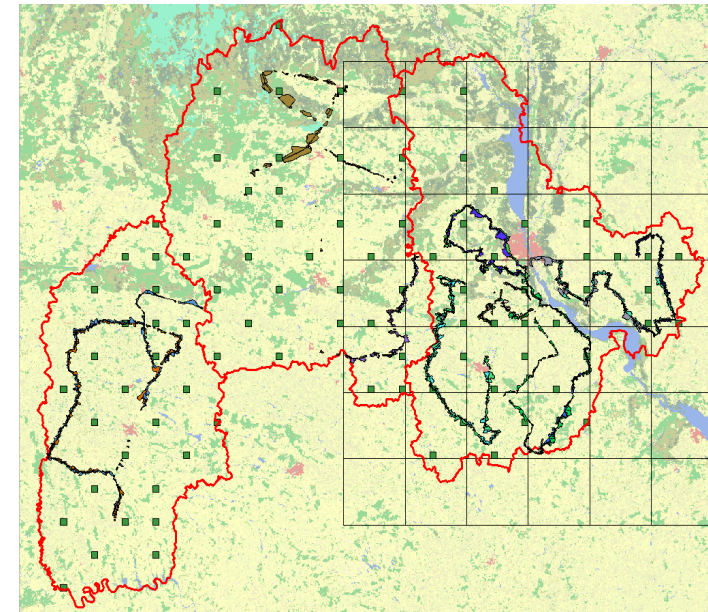
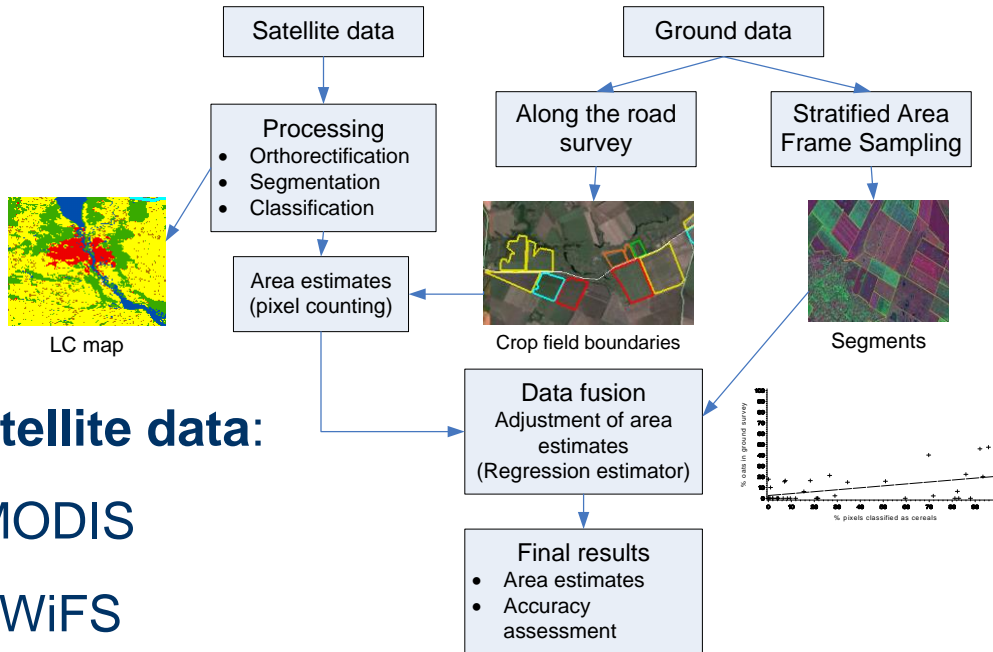


Contract no. 255189

“Crop area estimation with satellite images in Ukraine”



- Coordinator from JRC : **J.F. Gallego**



Area frame sampling (segments) and along the road surveys (curves)

Satellite data:

- MODIS
- AWiFS
- Landsat-5/TM
- LISS-III
- RapidEye

Efficiency of satellite data use for crop estimation:

Price is 1.5 lower

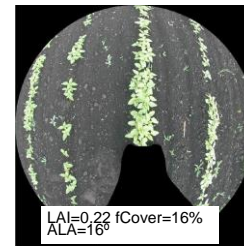
Project “Evaluation of the coherence between Copernicus products and crop biophysical parameters”



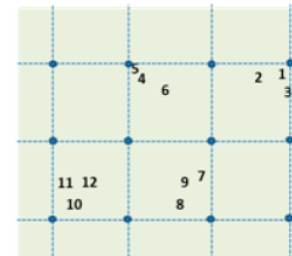
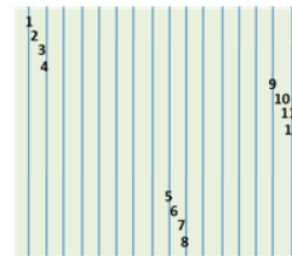
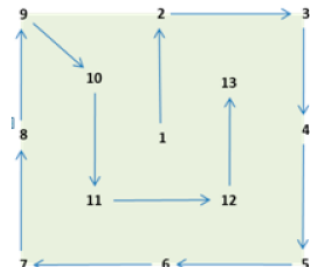
- Evaluation of the **relationship** between the **crop biophysical** parameters measured on field with or vegetation indices extracted from **high resolution sensors**; and an assessment of the uncertainties of low-resolution (1 km) **biophysical products** from **Copernicus** program.



DHP imagery samples

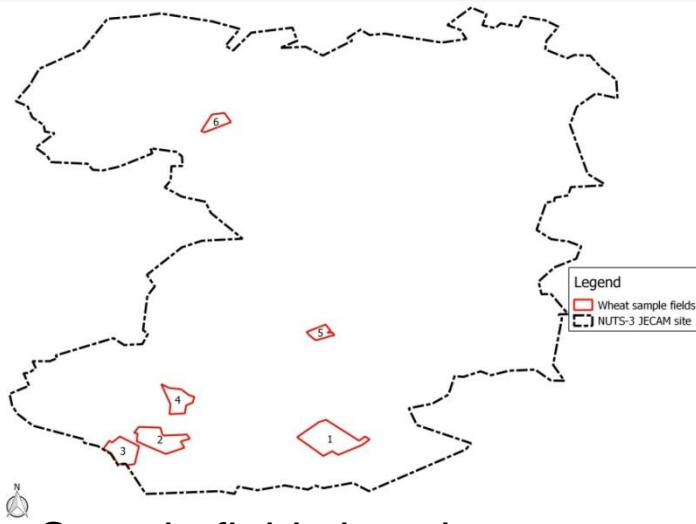


Results of processing with CAN-EYE

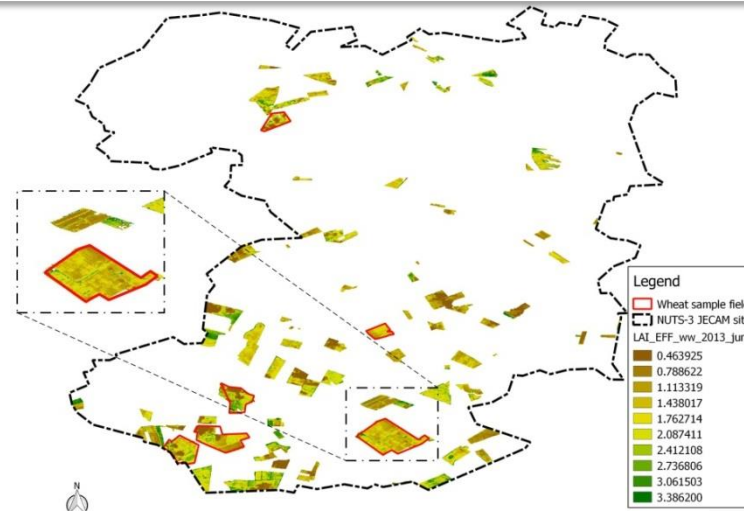


VALERI sampling strategies for **random** (left) or **row** (centre) and **regularly planted** vegetation (right).

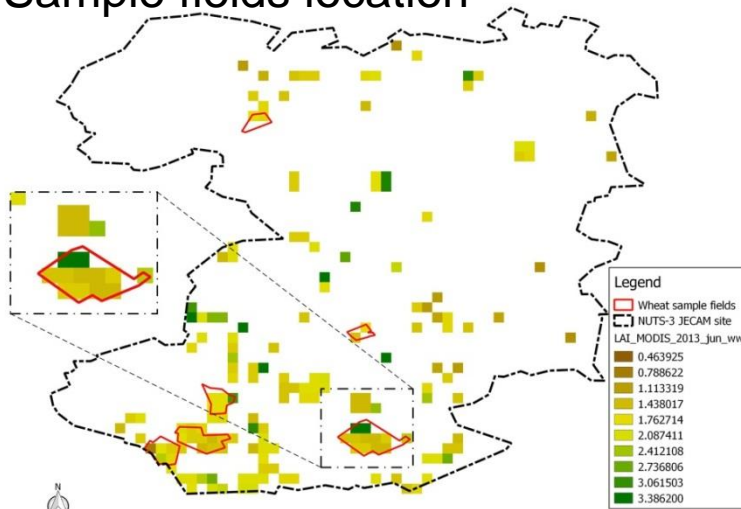
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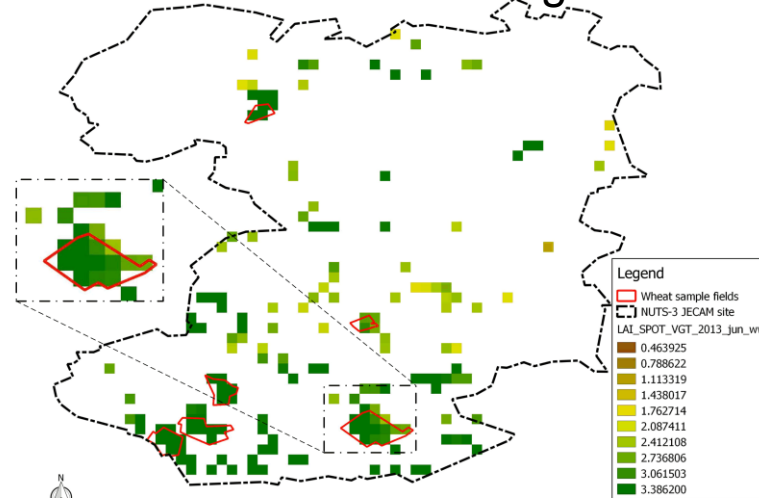
Sample fields location



Modelled on Landsat 8 and ground data



MODIS MOD15A2 product

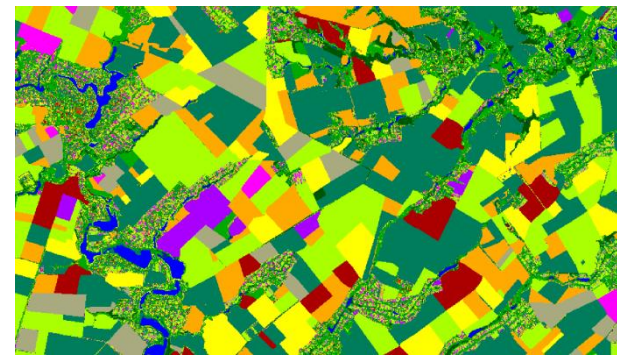


SPOT-VGT Copernicus product

Project “Parcel based classification for Agricultural Mapping and Monitoring (Ukraine)”



- Joint experiment on **parcel-based classification** for agricultural mapping and monitoring in Ukraine.
- **Study area** - Kiev Oblast (JECAM test site in Ukraine).
- **Methods of Classification and data:**
 - Proba-V and Sentinel-1/SAR, Landsat-8;
 - neural network based classifier (SRI);
 - multiple classifiers available in Google Earth Engine (GEE);
- Estimate **advantages** of the **GEE** cloud platform to efficiently process and classify **large volume of remote sensing data**, and as such enabling classification over large territories.

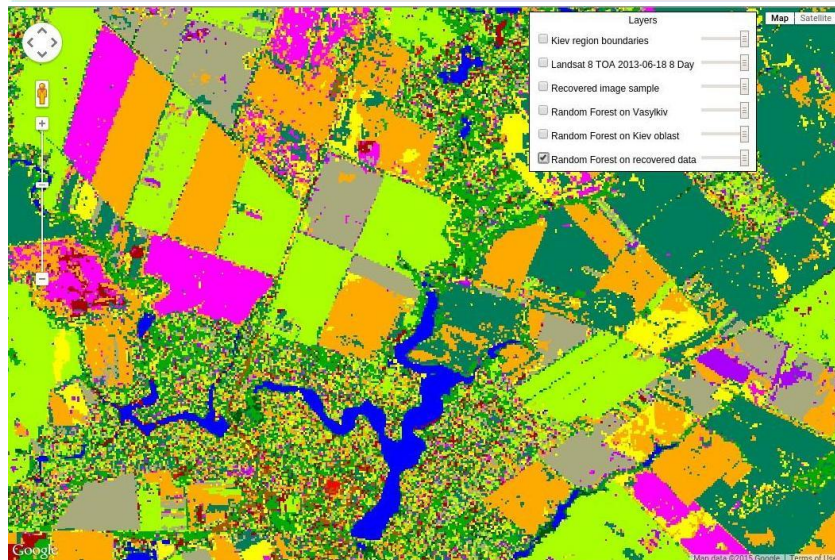
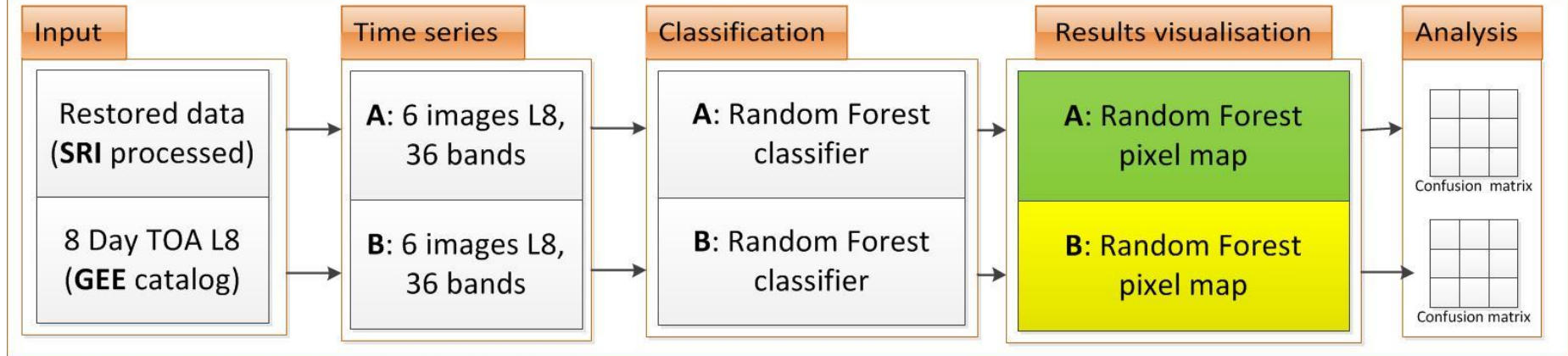


Results of CART, GEE

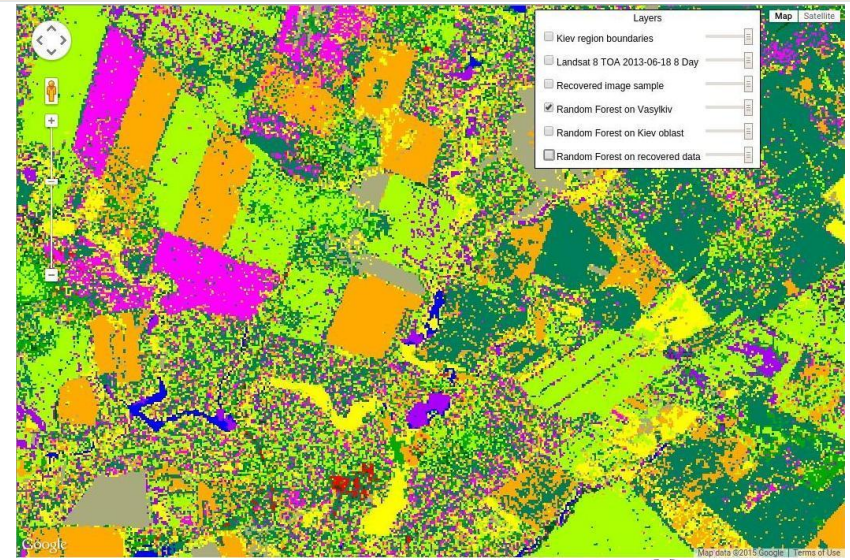
Data processing workflow



Experiment 1. Preferable input selection



A















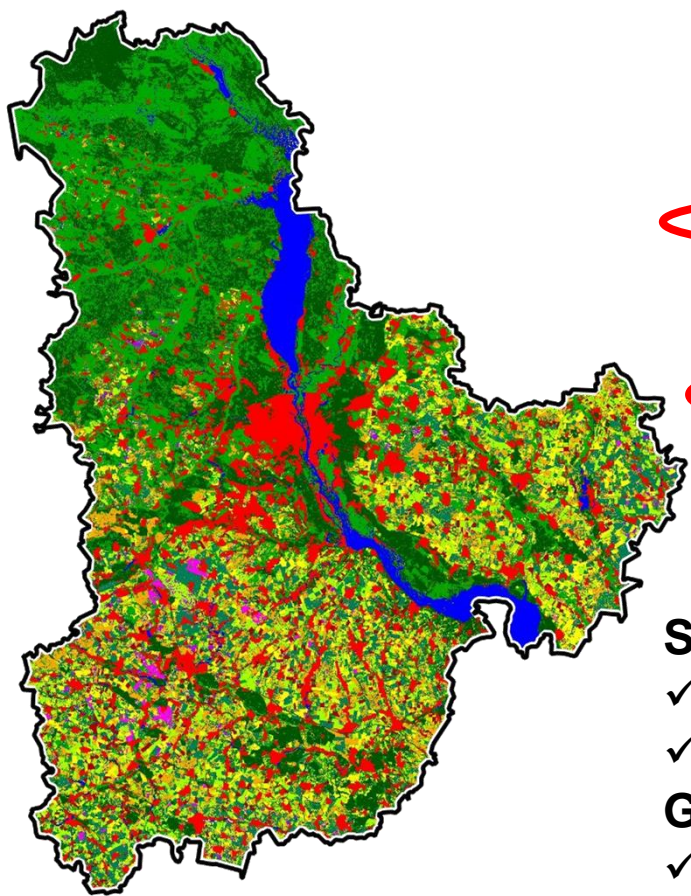
B

Multi mission crop classification (2015)



Legend

-  Artificial
-  Winter wheat
-  Winter rapeseed
-  Spring crops (wheat, barley)
-  Maize
-  Sugar beet
-  Sunflower
-  Soybeans
-  Forest
-  Grassland
-  Bare land
-  Water



KYIV OBLAST (2015)

Satellite

OA, %
pixel based

L-8 + S-1

92.7

SENTINEL-1

91.4

LANDSAT-8

85.4

Satellite data:

- ✓ 4 Landsat-8 scenes
- ✓ 15 Sentinel-1 scenes

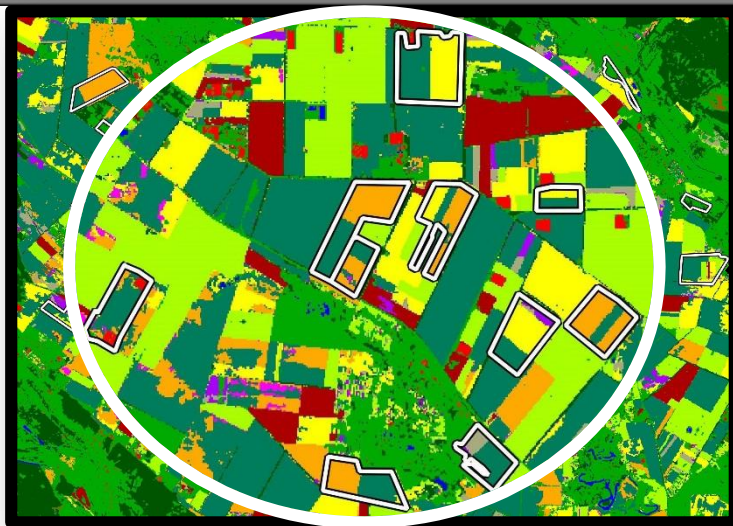
Ground data:

- ✓ 547 ground samples
(train and test sets)

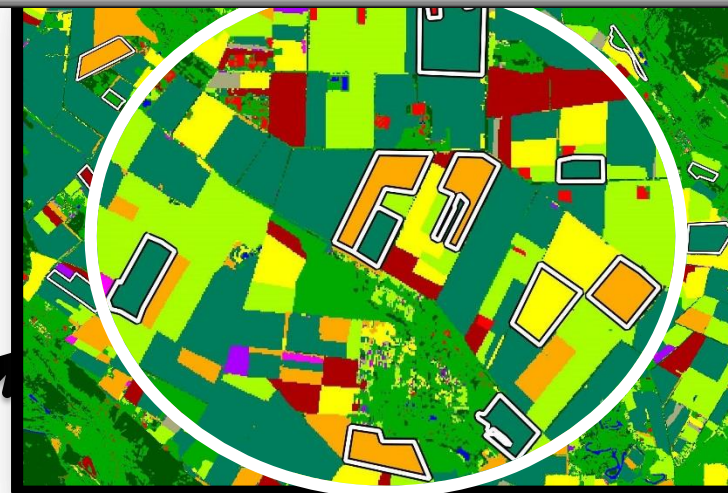
Filtration results (Kyiv oblast)



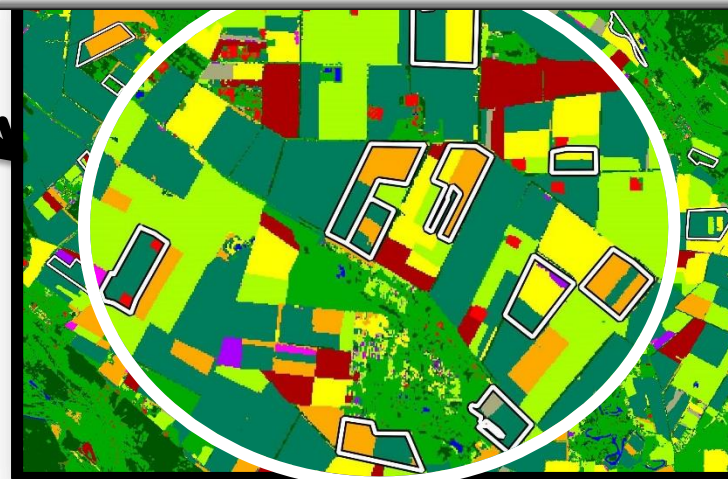
Pixel-based classification map



A majority voting scheme



Method that divides parcel into the fields



MARS approach in Ukraine (Ukr Hydrometcenter)



- Adopt
- Meteor
- Pla
- As
- Pla
- De
- Da
- A
- M
- De
- de

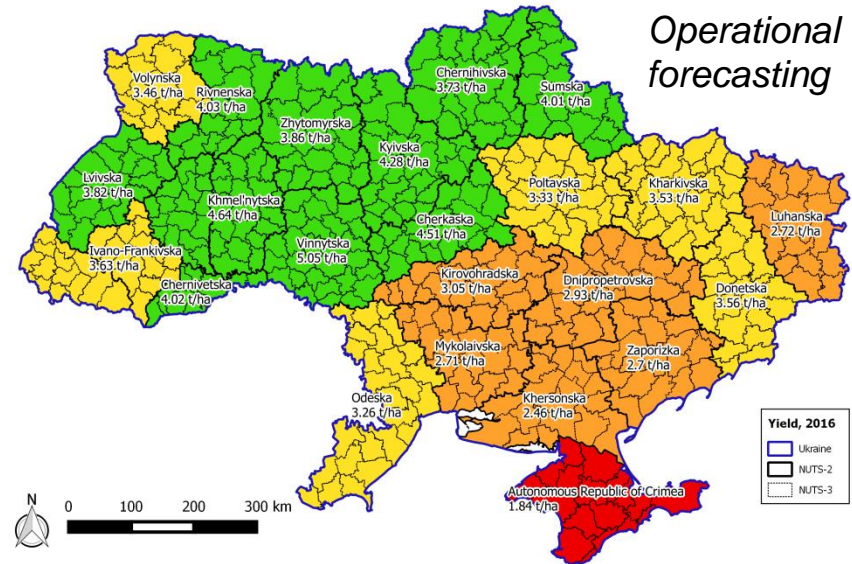


Crop yield forecasting: towards Monitoring Agricultural Resources (MARS)



- **Providing products since 2011 for Ukraine:**

- ESA GLOBCOVER cropland, 300 m, 2008
- MODIS MOD13Q1 **NDVI**;
- Statistical data from State Statistics Service of Ukraine;
- Up to 2 months before harvest



		2010	2011	2012	2013
NDVI	RMSE	8.2	6.2	6.8	5.8
	average	6.8	-3.7	-3.4	2
FAPAR	RMSE	8.9	5.2	5.6	4.1
	average	7.6	-2.1	-0.5	0.8



Challenges and further steps



- **Dedicated Program in NASU** to support national priorities and cooperation with JRC;
- **Implementation of MARS program** for crop yield forecasting in Ukraine;
- **GEOGLAM-Ukraine program** in line with GEO strategic plan to provide applied scientific results of satellite crop monitoring to Ministry of Agriculture



Thank you!
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