

Kyiv JECAM Site Progress (Ukraine)



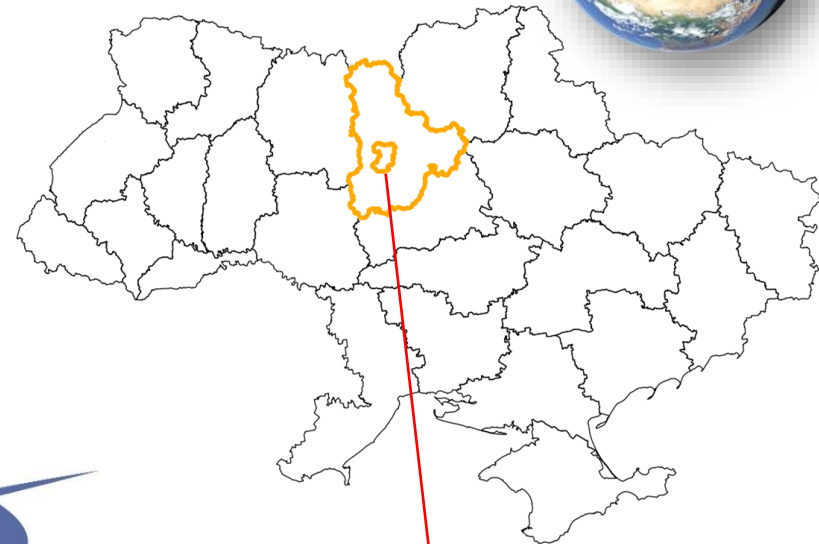
Prof. Nataliia Kussul, prof. Andrii Shelestov
Space Research Institute NASU-SSAU, Ukraine

Ukraine JECAM site



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



НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ
БІОРЕСУРСІВ І ПРИРОДОКОРИСТУВАННЯ
УКРАЇНИ



Map of intensive observation sub-site



Tasks for 2015

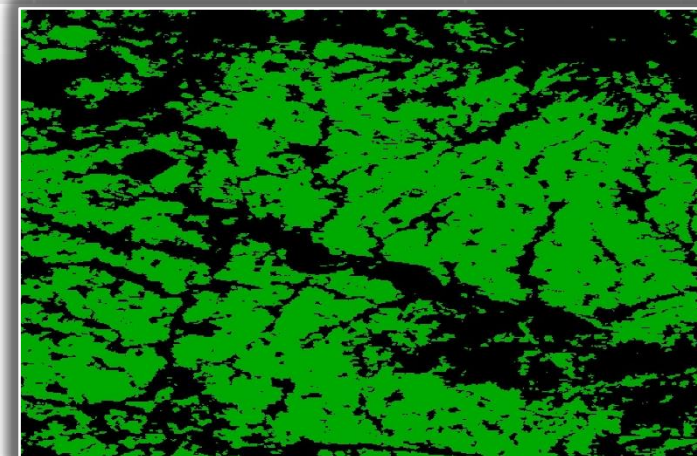
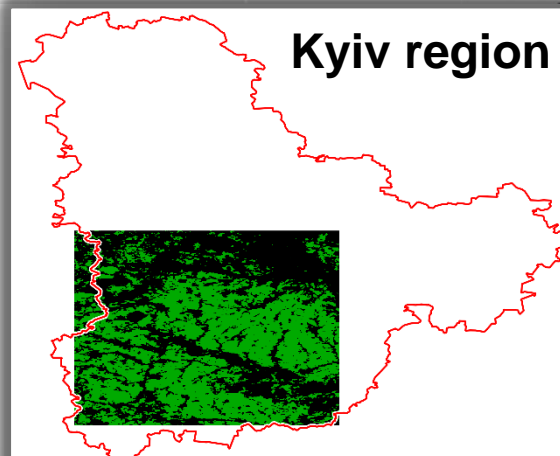
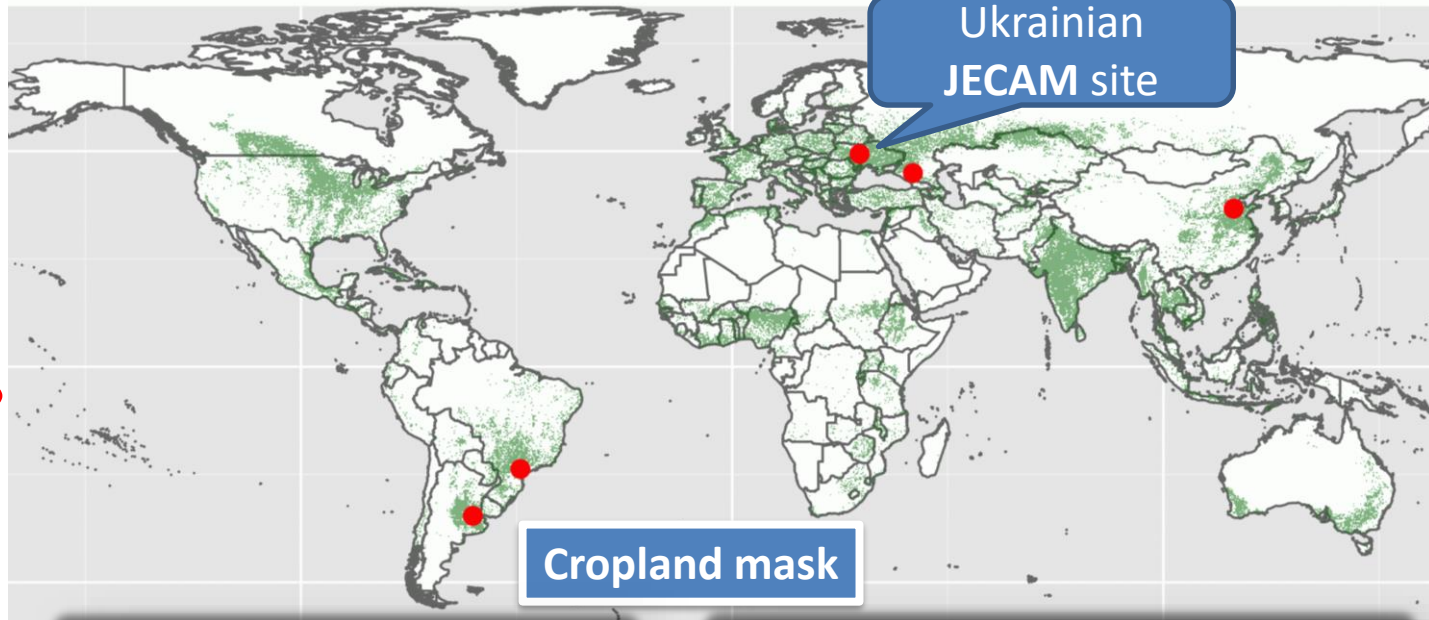


- Crop classification
 - 5 test sites experiment (based on Modis data)
 - Multimission experiment (Spot5 Take5)
- Bioparameters estimation
 - Spot5 Take5 experiment

5 JECAM test sites experiment



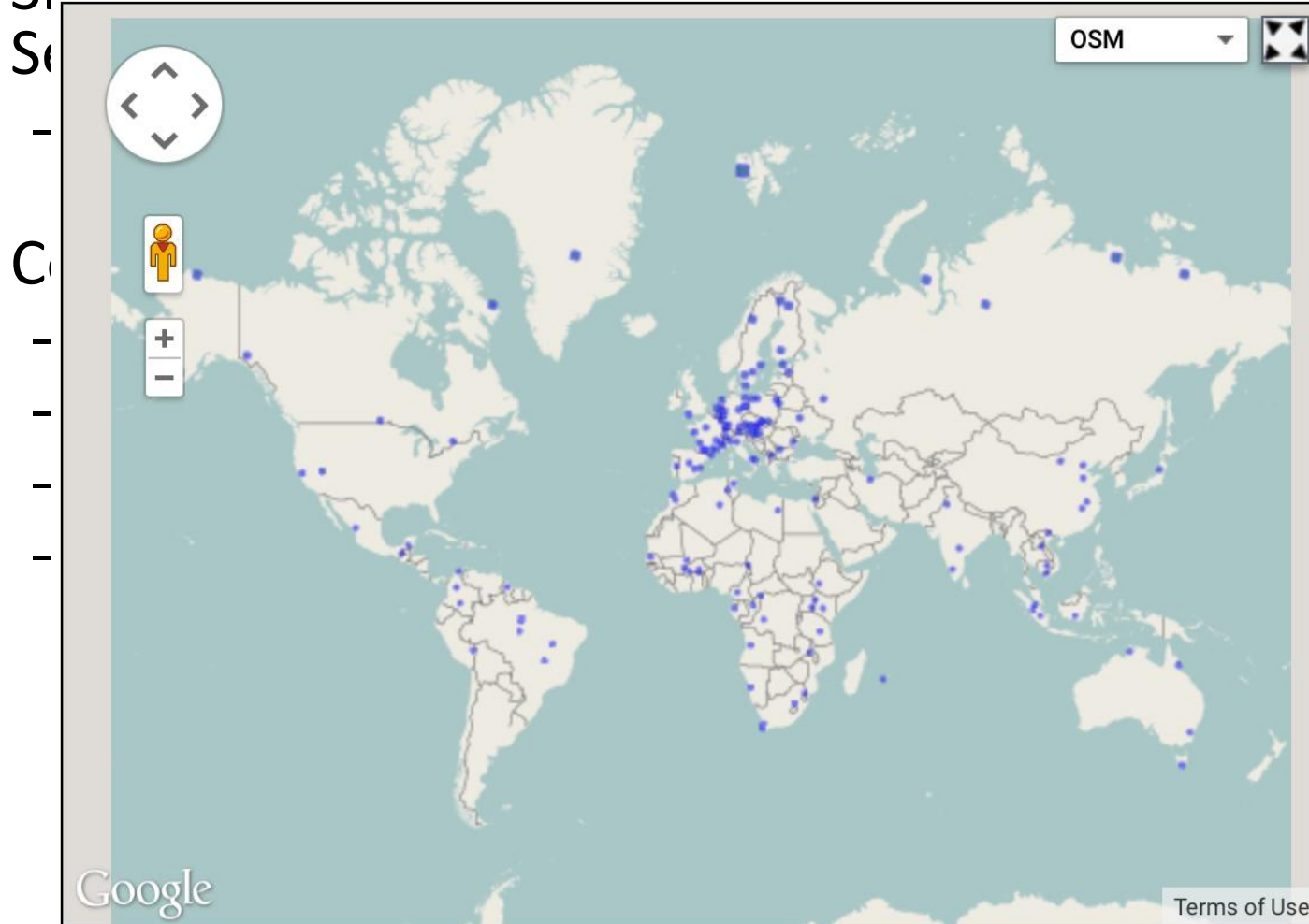
site	method	OA
Ukraine	iki	93.62
Ukraine	inta	96.58
Ukraine	radi	95.91
Ukraine	sri	98.04
Ukraine	ucl	97.58
Argentina	iki	90.74
Argentina	inta	92.66
Argentina	radi	90.52
Argentina	sri	95.49
Argentina	ucl	85.33
Brazil	iki	90.26
Brazil	inta	89.54
Brazil	radi	84.45
Brazil	sri	91.60
Brazil	ucl	91.15
China	iki	90.58
China	inta	91.23
China	radi	90.58
China	sri	90.58
China	ucl	88.31
Russia	iki	98.19
Russia	inta	95.40
Russia	radi	94.48
Russia	sri	98.38
Russia	ucl	95.21



SPOT5 Take5 experiment



- SPOT5 as a simulator of the image time series for



rational

- C

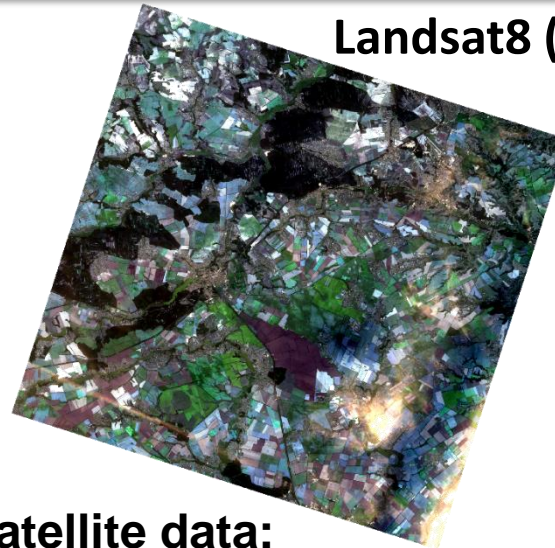
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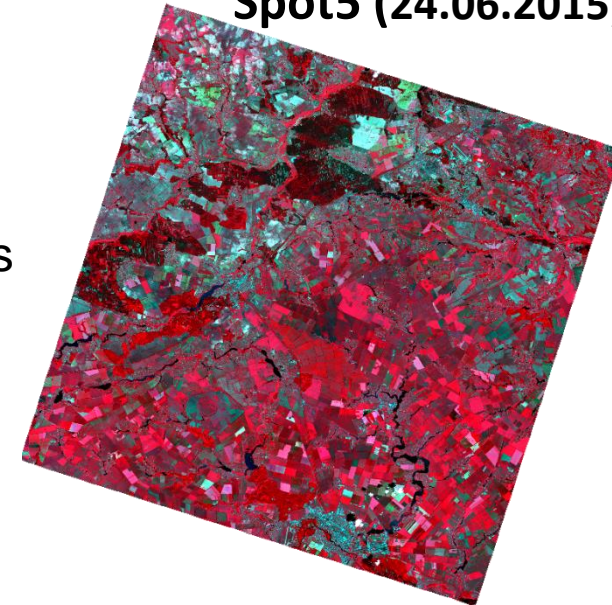
SPOT5 Take5: Satellite images and ground measurements



Landsat8 (28.08.2015)



Spot5 (24.06.2015)

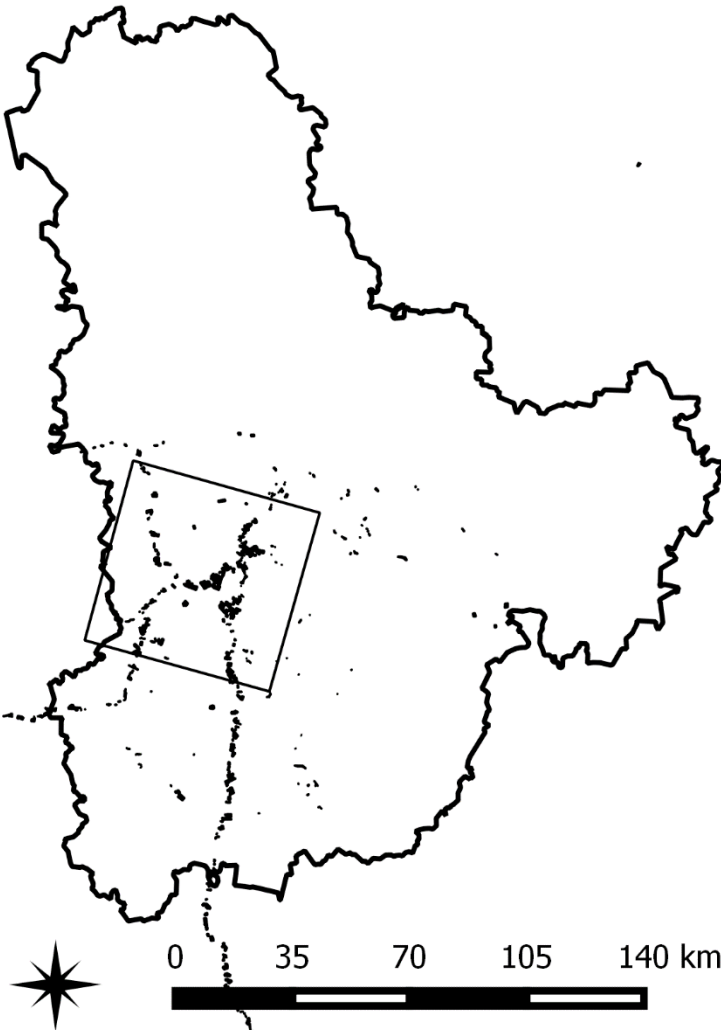


Satellite data:

- ✓ 4 Landsat-8 scenes
- ✓ 9 Proba-V scenes
- ✓ 12 Spot5 scenes
- ✓ 15 Sentinel-1 scenes

Ground data:

- ✓ 208 ground samples (train and test sets)



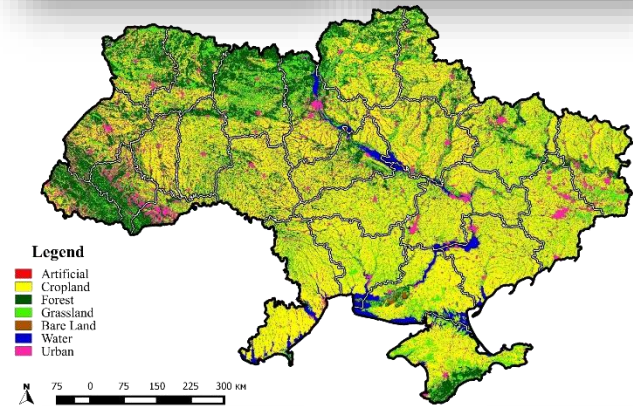
Classification method: deep learning



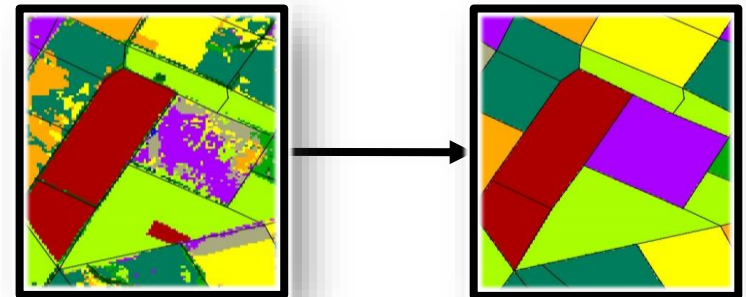
1. No-data pixels restoration (clouds and shadows) using self-organized Kohonen maps



2. Universal machine learning time series classification and modelling for the regional level based on neural networks ensemble



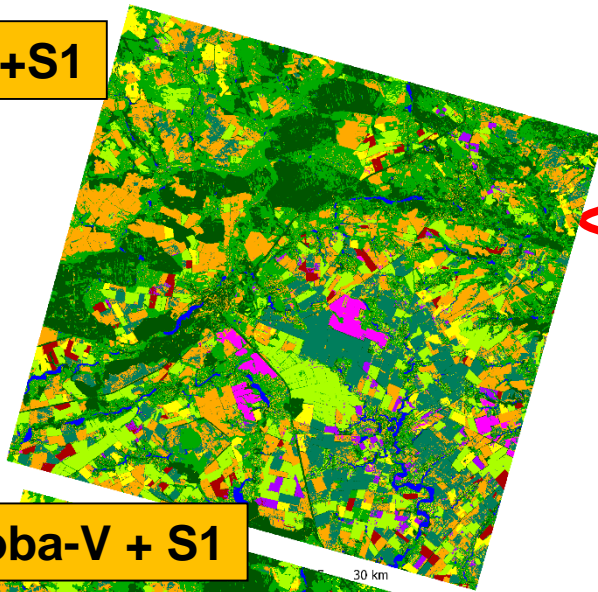
3. Map filtration (voting and weighted voting approaches with division parcels into the fields)



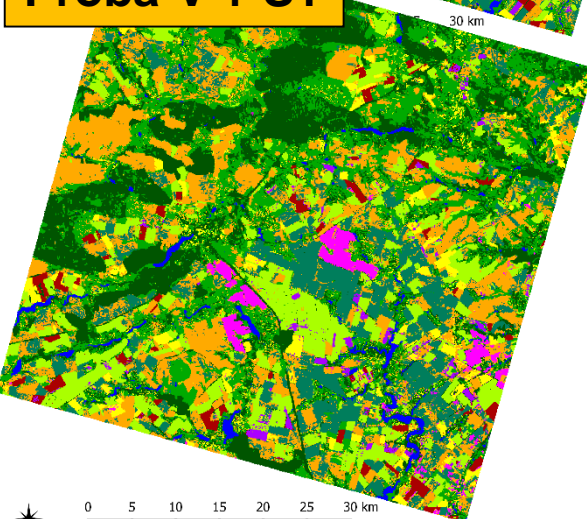
Spot5 Take 5: Multi mission crop classification (2015)



L8+S1

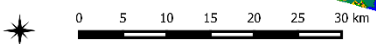


Proba-V + S1



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

Satellite	OA, % pixel based
PROBA-V + S1	90.6
L8 + S1	90.3
SENTINEL-1	90.3
L8 + SPOT5 + S1	89.2
SPOT5 + S1	89.1
L8 + SPOT5	87.7
SPOT5	86.3
LANDSAT-8	86.1
PROBA-V	83.4



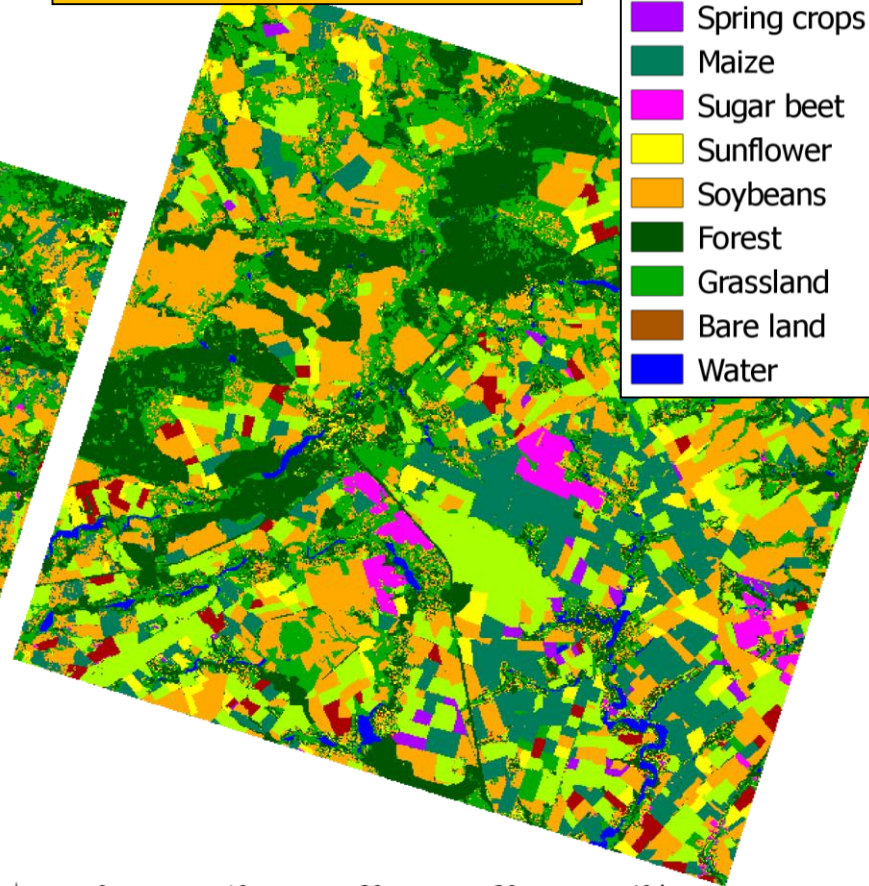
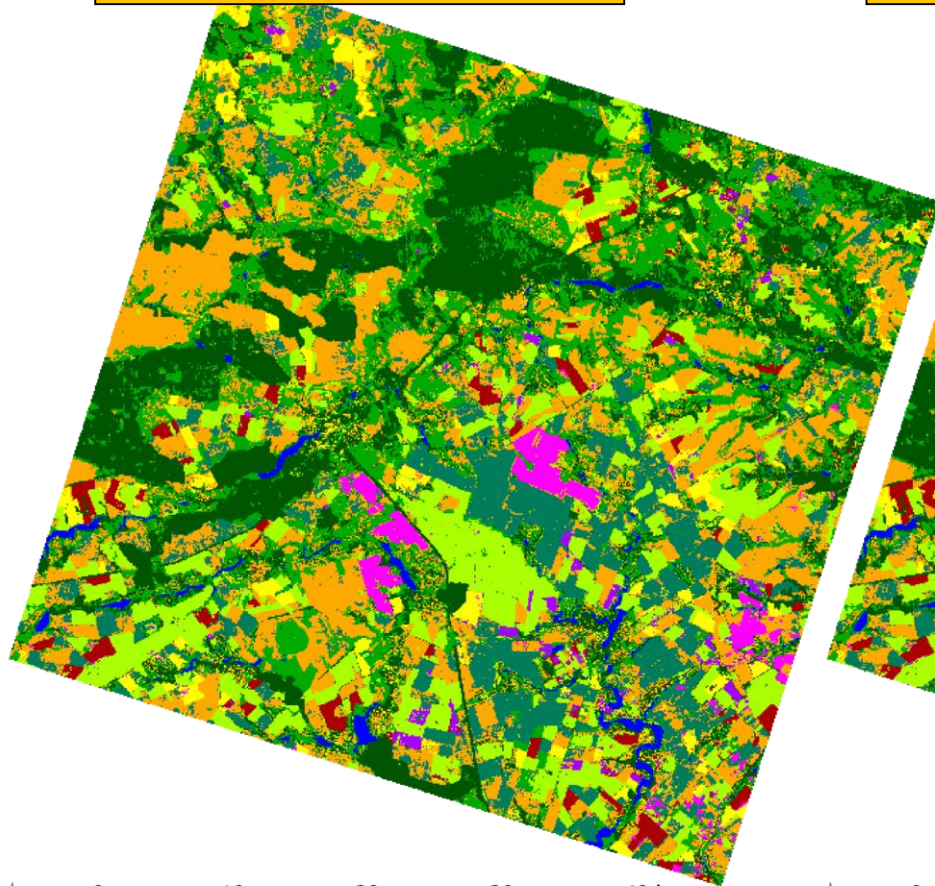
Crop map filtration



**Proba-V + S1
(OA = 90.6%)**

**Proba-V + S1 Filtered
(OA = 91.6%)**

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



Multi mission crop classification (2015)



KYIV REGION

■ Artificial
■ Winter wheat

Satellite

**OA, %
pixel based**

S1 92.7

A-V + S1 92.3

NEL-1 91.4

SAT-8 85.4

A-V 84.6

	Official statistics (1000 ha)	Classification results (L8 + S1) (1000 ha)
Artificial	195.2	219.8
Winter wheat	35.5	42.8
Soybeans	241.7	183.2
	15.7	13.1
	116.9	116.2
	216.5	296.9

Soybeans

SPOT5 Take5: Biopar estimation. Data description

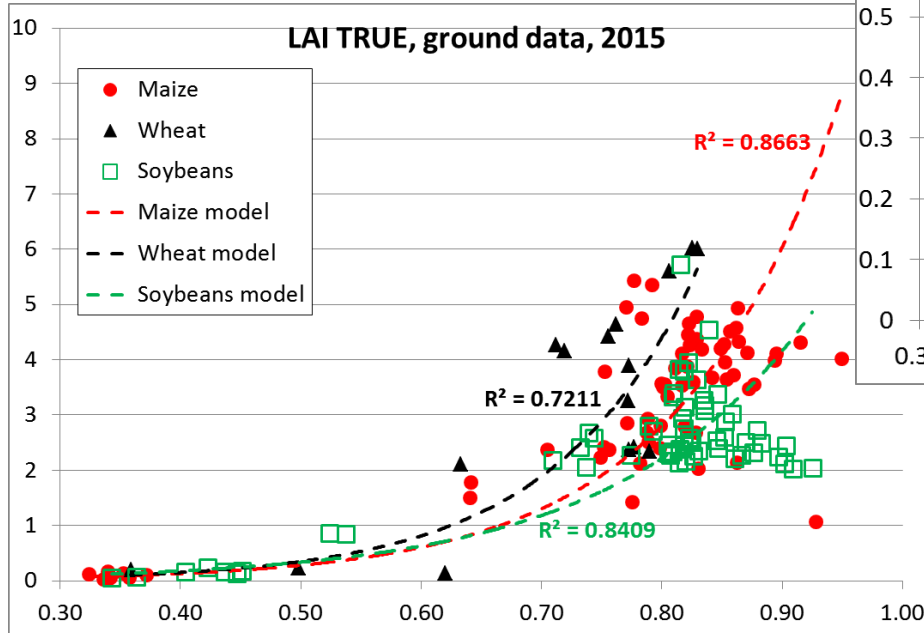
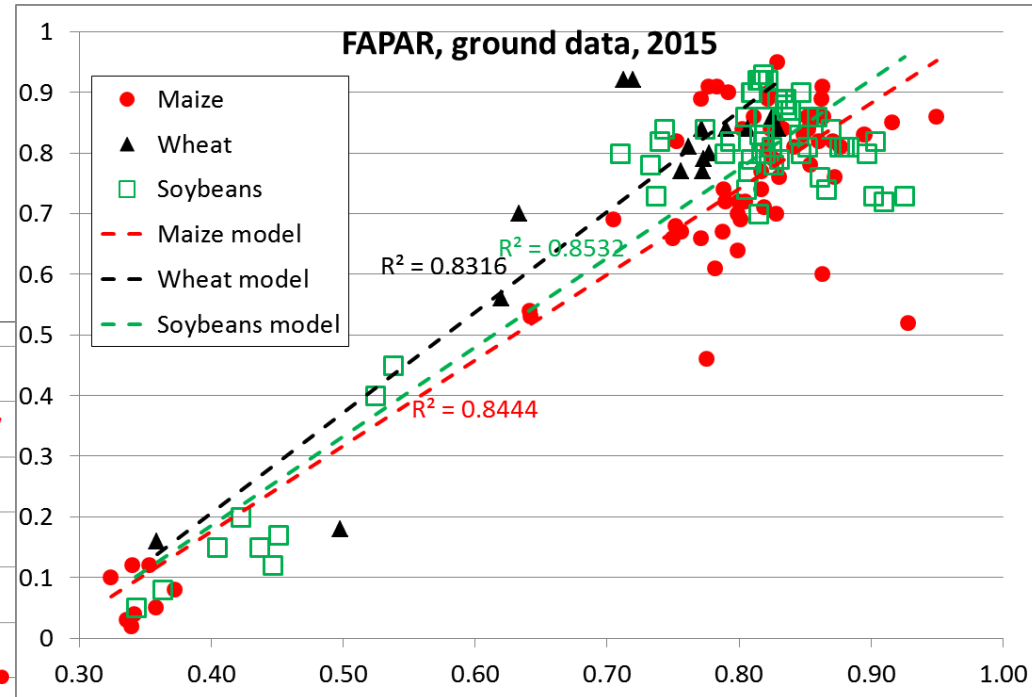
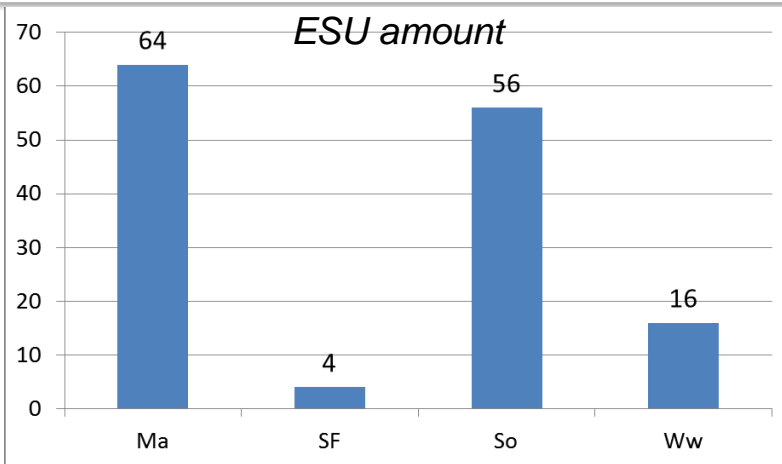


- 23 tiles (2015/04/10 - 2015/09/02);
- Ground data (ESU) for cloud free images (9 tiles)

#	Tile	Date of survey	ESU	Δ DOYS
1	2015-04-25	22-04-2015	7	3
2	2015-05-25	26-05-2015	13	1
3	2015-06-04	03-06-2015	10	1
4	2015-06-14	16-06-2015	17	2
5	2015-06-24	23-06-2015	27	1
6	2015-07-09	07-07-2015	26	2
7	2015-07-19	19-07-2015	14	2
8	2015-07-24	23-07-2015	26	1
		total	140	

- Crop specific models (Maize, wheat, soybeans)

Ground data: Ma, Ww, So



Bioparameters models



Model type	R ²	RMSE	F-stat
Maize			
<i>LAI, exp</i>	0.86	0.5	405
<i>FAPAR, linear</i>	0.84	0.1	337
Winter wheat			
<i>LAI, exp</i>	0.72	0.65	36
<i>FAPAR, linear</i>	0.83	0.09	69
Soy beans			
<i>LAI, exp</i>	0.84	0.4	307
<i>FAPAR, linear</i>	0.85	0.09	318

- ✓ Statistically adequate
- ✓ Reliable

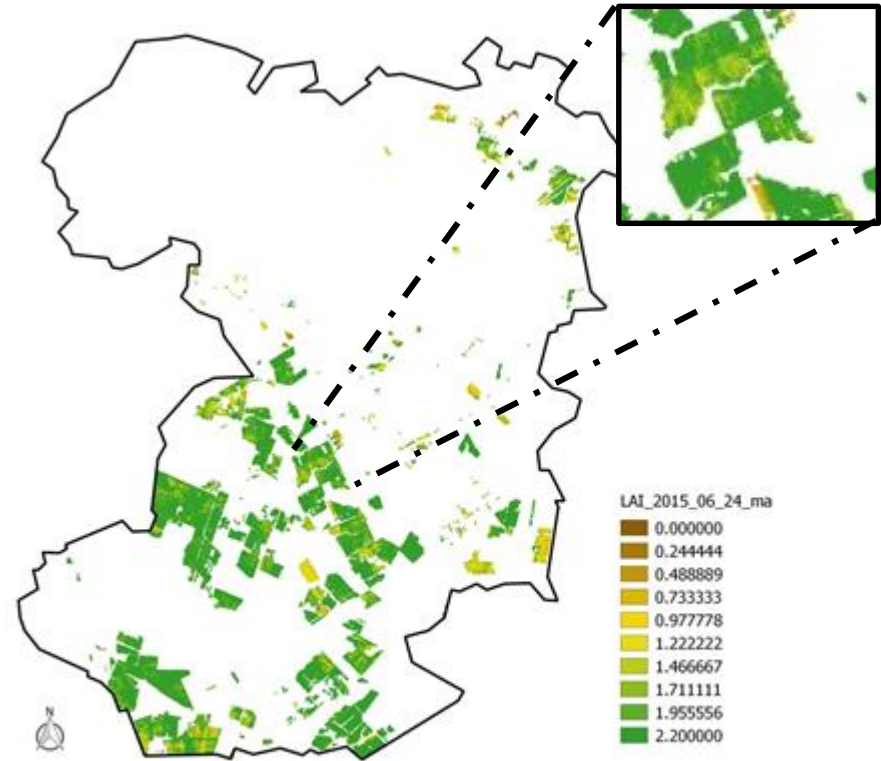
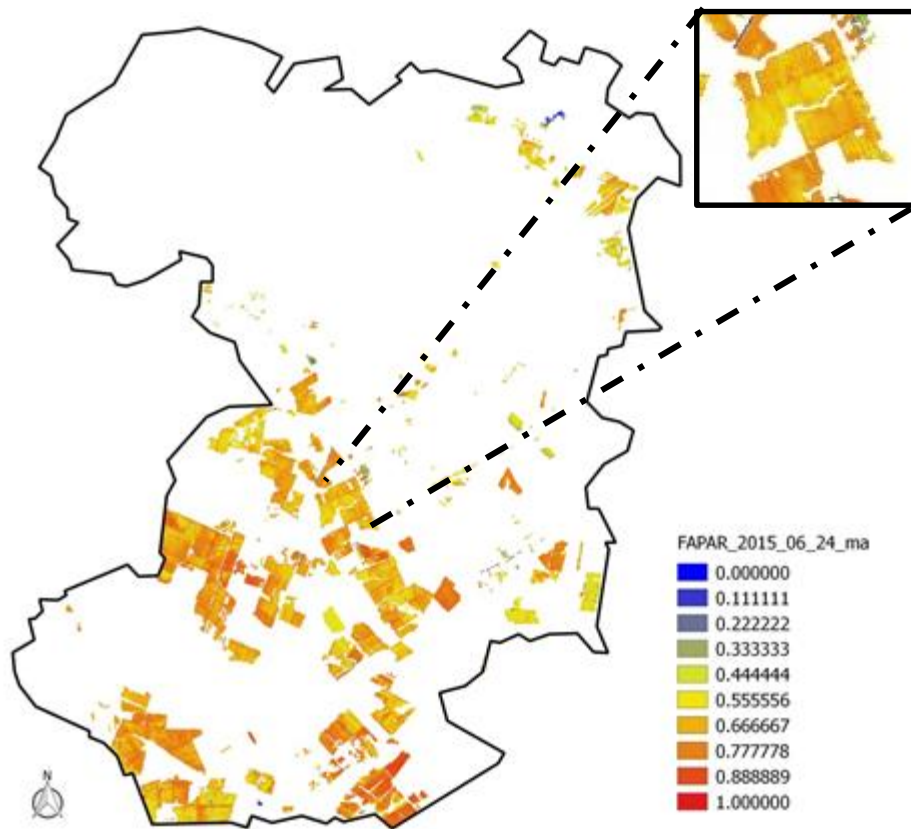
$$FAPAR = c * NDVI + d$$

Linear relation

$$LAI = a \times e^{k \times NDVI}$$

Exponential relation

Maize bioparameters sample



Collaboration, 2015



1. Large scale classification experiment
(coordinated by Pierre)
2. ImagineS project – global biopar products validation
3. ESA Spot5 Take5 experiment



Prospects



- **Country level pre-operational demonstration on crop mapping within Sen2Agri Project**



- **Horizon 2020 ERA-PLANET Project:**
THE EUROPEAN NETWORK FOR OBSERVING OUR
CHANGING PLANET

The goal of **ERA-PLANET** is to **strengthen the European Research Area** in the **domain of Earth Observation** in coherence with the European participation to Group on Earth Observation (GEO) and Copernicus.

41 organizations with 11 million budget by **EC (European Commission)**

References



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IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing. - 2015. - DOI: 10.1109/JSTARS.2015.2454297.
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N. Kussul, S. Skakun, A. Shelestov, M. Lavreniuk, B. Yailymov, O. Kussul
International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences. – 2015. - P. 45-52.
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A. Kolotii, N. Kussul, A. Shelestov, S. Skakun, B. Yailymov, R. Basarab, M. Lavreniuk, T. Oliinyk, V. Ostapenko
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Thank you!

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