

# **A European parcel level crop type map based on Sentinel 1 and LUCAS Copernicus in-situ observations**

Raphaël D'ANDRIMONT <sup>1</sup>, Astrid VERHEGGHEN <sup>1</sup>, Michele MERONI<sup>1</sup>, Guido LEMOINE <sup>1</sup>,  
Beatrice EISELT <sup>2</sup>, Peter STROBL <sup>1</sup>, Pieter KEMPENEERS<sup>1</sup> and Marijn VAN DER VELDE <sup>1</sup>

<sup>1</sup> European Commission, Joint Research Centre (JRC), 21027 Ispra, Italy

<sup>2</sup> European Commission, Eurostat (ESTAT.E.4), L-2920 Luxembourg

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# LUCAS Survey — land use and land cover across the European Union to monitor socio-environmental challenges

- On-site data collection
- Land use / land cover
- Environmental information
- EU-wide (28 countries)
- Standard survey methodology:  
Two phase sampling, classifications, data collection processes.
- Adapted to policy needs:  
Flexible, ad-hoc modules.
- Reduced statistical burden: No questionnaires for farmers, land owners.

## Land cover:

### BIOPHYSICAL COVERAGE OF LAND

LUCAS: 76 subclasses

Artificial land



Cropland



Woodland



Shrubland



Grassland



Bare land



Water areas



Wetlands



## Land use:

### SOCIO-ECONOMIC USAGE MADE OF LAND

LUCAS: 33 subclasses

#### Primary sector:

(for example, agriculture and forestry)



#### Secondary sector

(industry)



#### Tertiary sector

(services)



#### Other uses

(for example, residential use and abandoned areas)



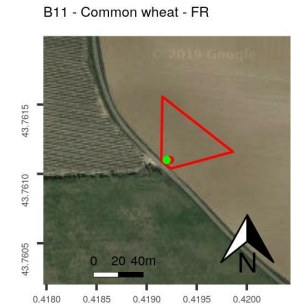
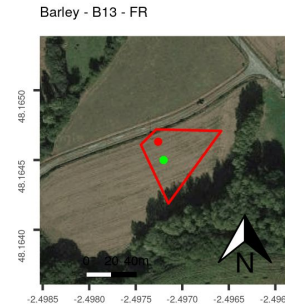
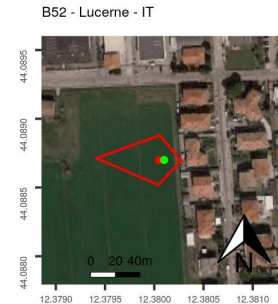
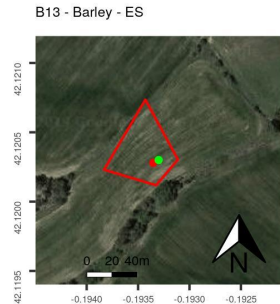
# LUCAS Copernicus in-situ survey - polygons

The training dataset is built from Copernicus LUCAS 2018

- LUCAS Copernicus component is a pilot to provide in-situ data for training and validation algorithm for remote sensing data
- Exact location of the observation (VS theoretical for normal LUCAS)
- Pure Land Cover extent within 50 m from the points (N, E, S, W)
- 63,364 LUCAS points surveyed with the Copernicus requirements
- Cleaning and construction of polygons

**Table 2.** Filtering of the LUCAS points in order to obtain high-quality LUCAS points (conditions 1 to 4) and LUCAS Copernicus polygons (conditions 1 to 8).

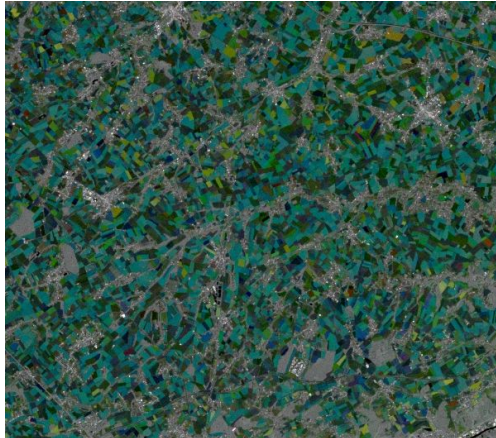
Condition	Description	Variable	N
1	Observation selected only if the point was visible (i.e. direct observation)	OBS_TYPE <3	215120
2	Direction of observation is on the point	OBS_DIRECT = 1	323807
3	Parcel are >0.1 Hectare	PARCEL_AREA_HA >1	319513
4	Land cover class covers more than 90% of the observation	LC1_PERC >90	292571
5	Copernicus survey was possible	CPRN_CANDO = 1	63364
6	Next land cover in N, E, S,W is further than 5 meters	min(CPRN_LC1N, CPRNC_LC1E, CPRNC_LC1W, CPRNC_LC1S) >5	59210
7	GPS distance to theoretical point should be smaller than 45 meters	OBS_DIST <40	193023
8	Land cover class observed at the Copernicus point has the same Land cover (level 2) as the LUCAS point	LC1 (level 2) = CPRN_LC1 (level 2)	60547
Filtered LUCAS points (fulfilling conditions 1 to 4)			154027
Filtered LUCAS Copernicus polygons (fulfilling condition 1 to 8)			42815



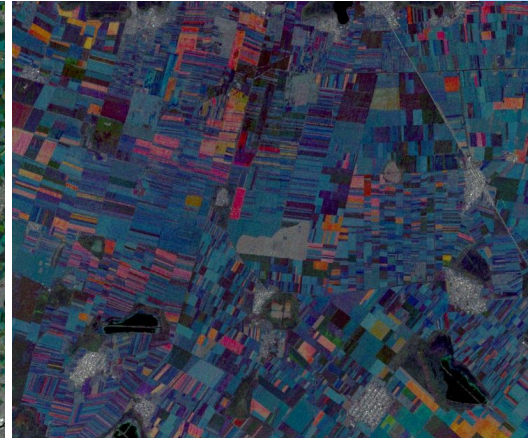
# Sentinel 1 GRD

Sentinel-1 GRD accessed in Google Earth Engine

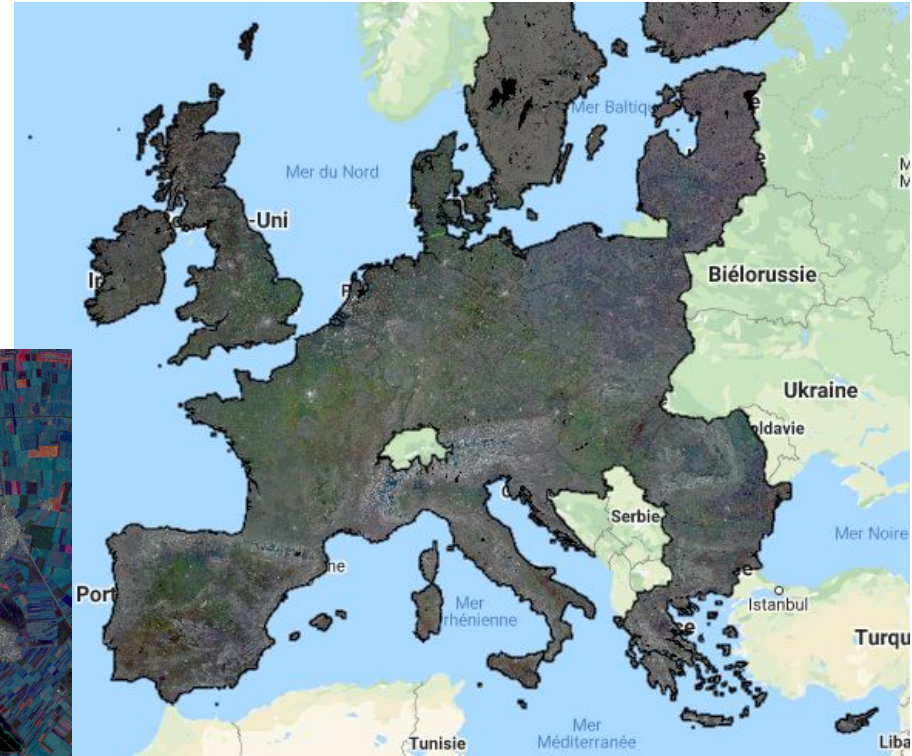
- 10 days average VV and VH backscatter
- 1st January to 31st of July 2018
- 10-meter resolution



Belgium



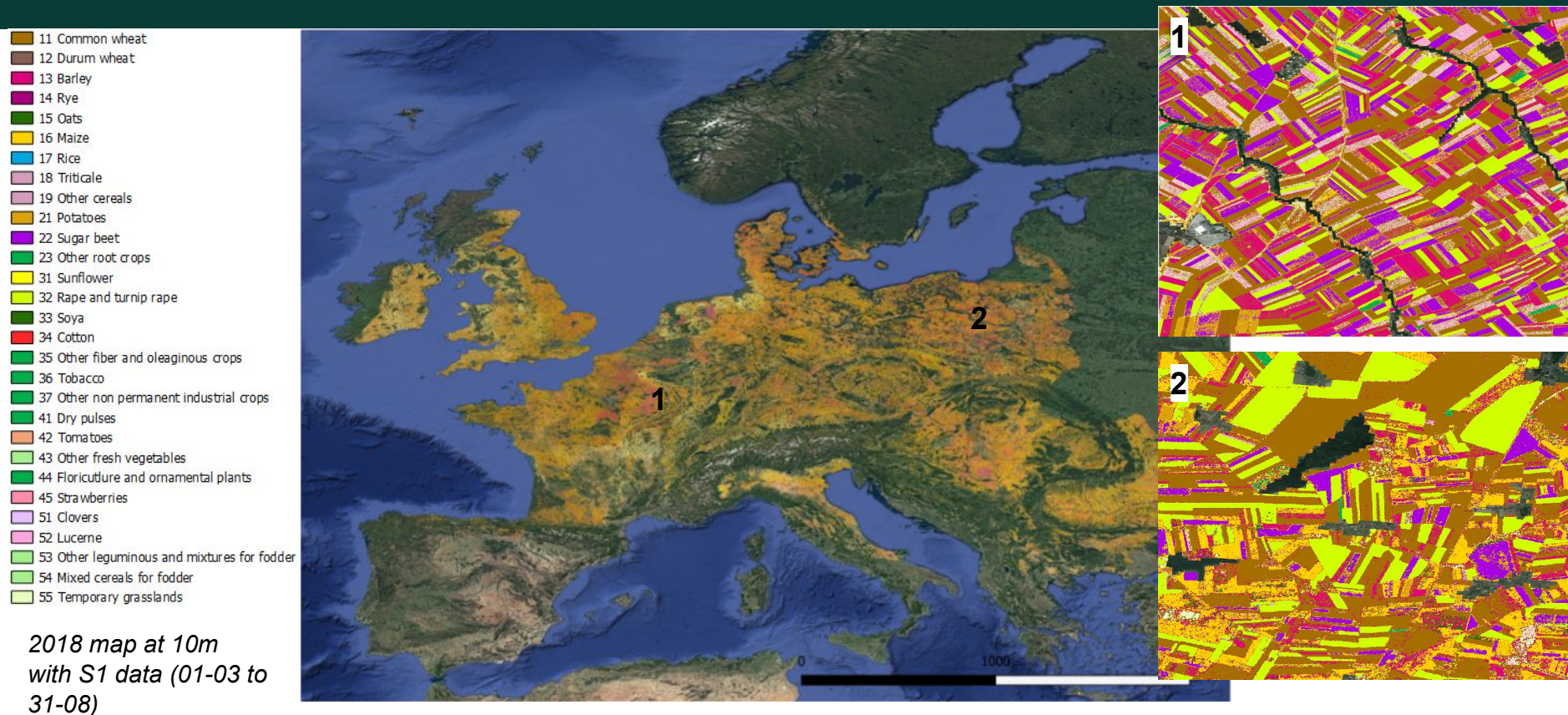
Romania



R:VH20180511, G: VH20180610, B:VH20180710



# Crop type mapping at European scale (prototype)



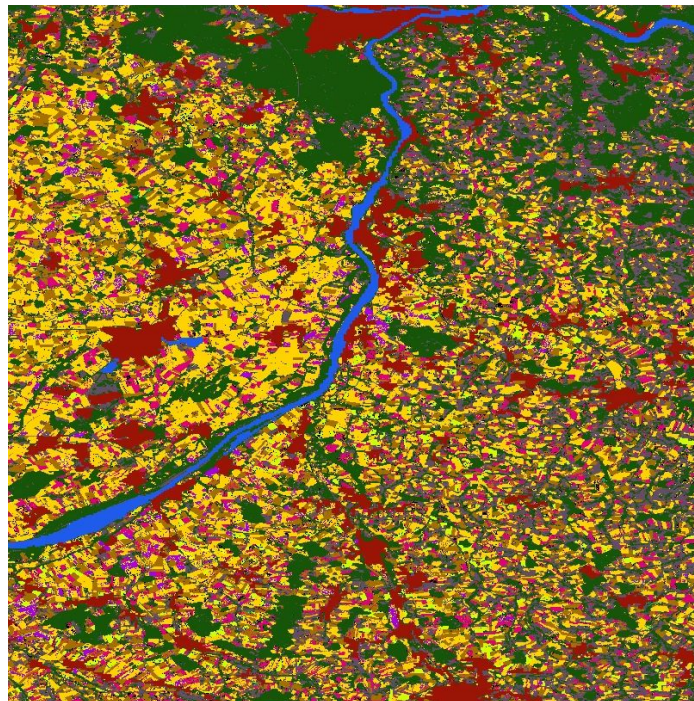
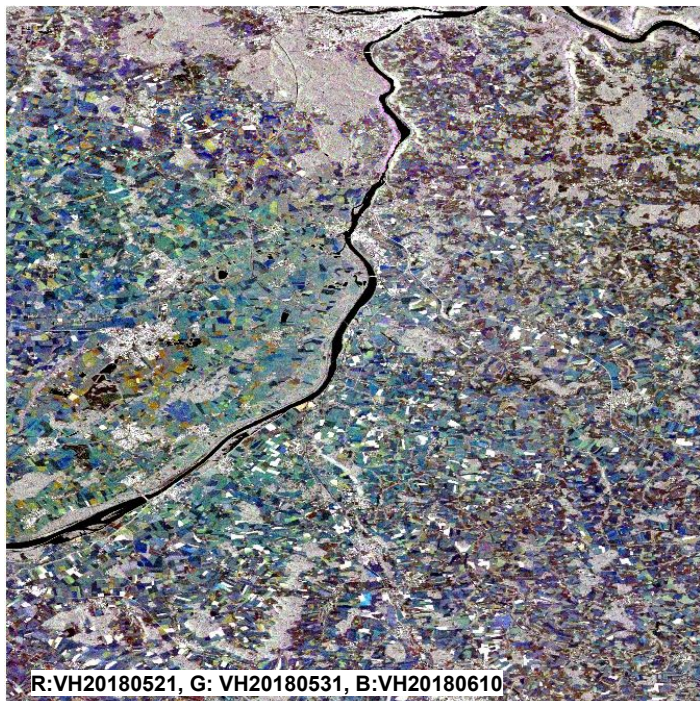
# First crop type map at the scale of Europe using Sentinel-1 data and in-situ LUCAS Copernicus survey

- **Input data:** Sentinel-1 GRD
  - 10 days average VV and VH backscatter
  - 1st January to 31st of July 2018
  - 10 meter resolution
- **Training dataset:** LUCAS Copernicus in-situ survey 2018  
42,795 polygons (6,905 for cropland)
- **Supervised classification:** Random Forest Classifier  
Hierarchical legend
  - Level 1) land cover
  - Level 2) crop types
- **Validation:** LUCAS Copernicus in-situ survey 2018  
111,212 points (26,273 for cropland)



# Prediction of the Classification

- Prediction at scale for Europe on the JEODPP (JRC infrastructure)
- Example for a tile (border Germany and Austria)



## **Biome**

Continental

## **Nb trees**

130

- |   |                         |
|---|-------------------------|
|  | 11 Common wheat         |
|  | 12 Durum wheat          |
|  | 13 Barley               |
|  | 14 Rye                  |
|  | 16 Maize                |
|  | 17 Rice                 |
|  | 18 Triticale            |
|  | 19 Other cereals        |
|  | 21 Potatoes             |
|  | 22 Sugar beet           |
|  | 23 Other root crops     |
|  | 31 Sunflower            |
|  | 32 Rape and turnip rape |
|  | 33 Soya                 |
|  | 55 Temporary grasslands |

# Main crop type accuracy

## LUCAS point as Validation dataset

Prediction at the end of July (22 decades of VV and VH backscatter)

Producer accuracy, User accuracy and F-1 score for main crops

	Cereals					Root crops		Non permanent industrial crops	
	Common Wheat	Durum Wheat	Barley	Rye	Maize	Potatoes	Sugar beet	Rape and turnip rape	Sunflower
Producer Accuracy (omission) %	81	53	51	27	83	24	71	77	71
User Accuracy (commission) %	58	57	60	52	71	73	65	90	77
F1 score %	68	55	55	36	77	36	68	83	74



# Conclusions

LUCAS Copernicus component has high potential for remote sensing community to generate timely LC information and more:

- Location and validation of Land Cover boundaries
- Training and validation database for automatic image recognition
- Extending a professional survey using citizen science approaches
- Contributing to global free & open in-situ databases for EO analysis
- Linking sample and areal based Land Cover extent estimates
- Trigger better integration of statistical and geospatial domains