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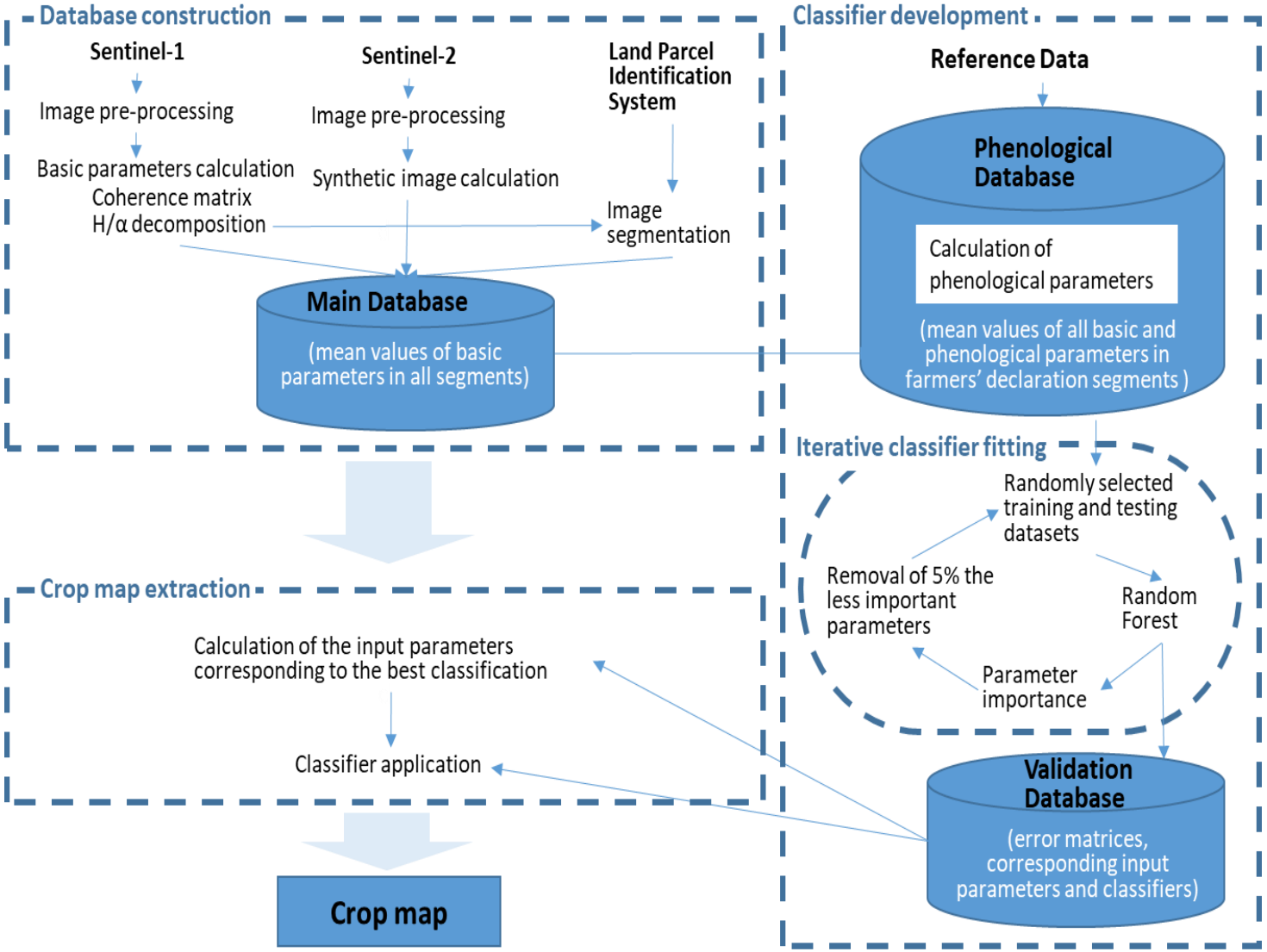
Use of satellite data and remote sensing methods for statistical production.

Przemysław Slesiński
Natalia Kotulak

02.07.2024 Warsaw

System for estimating the crops area

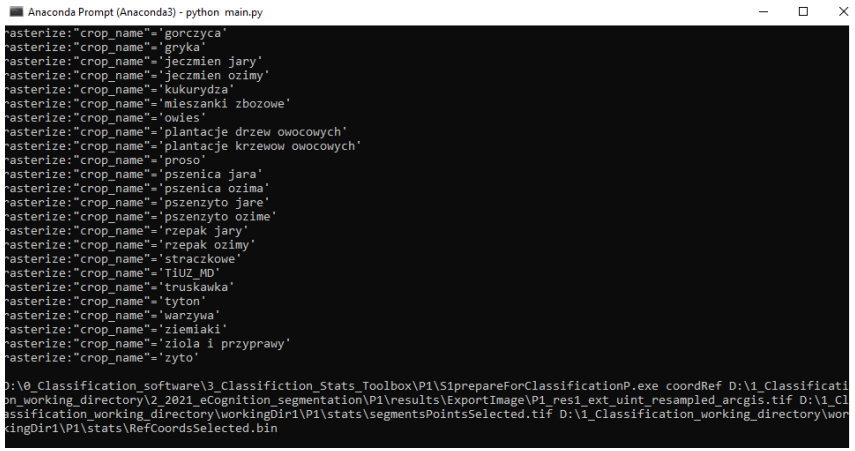


System for estimating the crops area

Classification Module	Processing up to 7 days

Total processing time up to **2 months,** approx **30TB** of date are being processed

- ClassificationProcess
- Configuration
- configurationEmpty
- configurationFile
- FeaturesMangerS1S2
- FulllmageClassification
- gdal204.dll
- InfoPrinter
- IterativeFeatureReduction
- main
- manual
- RasterObject
- Readme.md
- S1prepareForClassificationP
- StatsCreator
- StatsReader

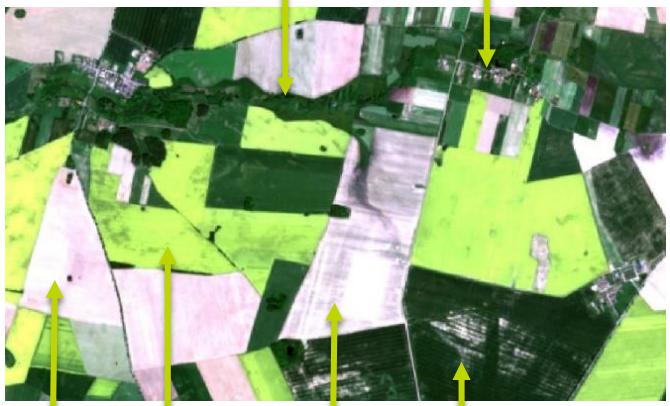


Object based image classification

- How does the whole process look like?

Forest Urban

Satellite data



Winter rape
Sugar beet
Corn
Winter wheat

+

Administrative data

- cadastral parcels vector (LPIS)
- information on crops declared by farmers (ARMA)
- agricultural plots borders from Land Use\land Cover (ARMA)

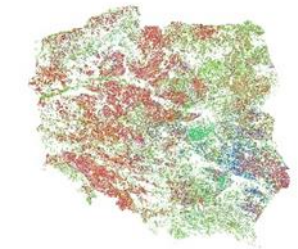
Segmentation

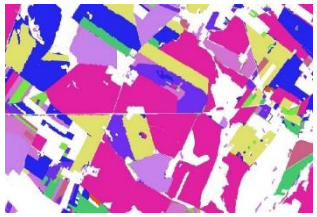
Supervised classification

Machine learning algorithms

Each pixel or object is compared to sample and then is classified

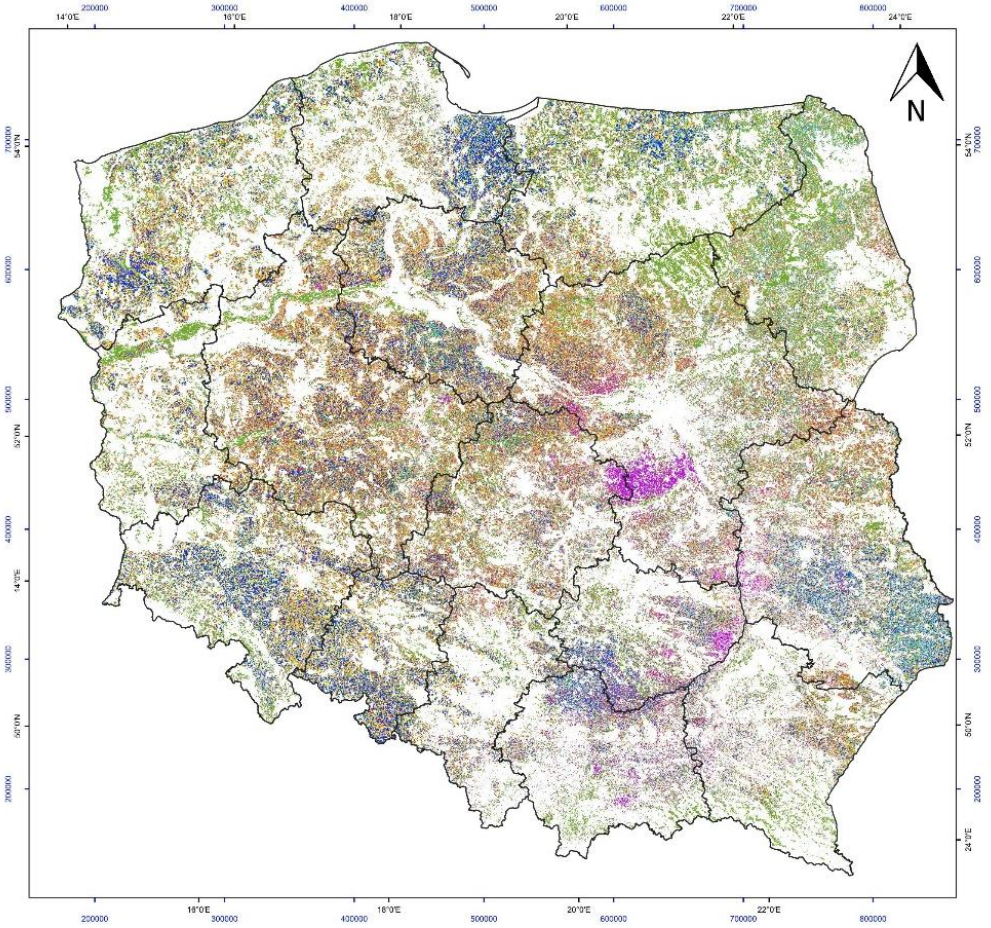
Crops map

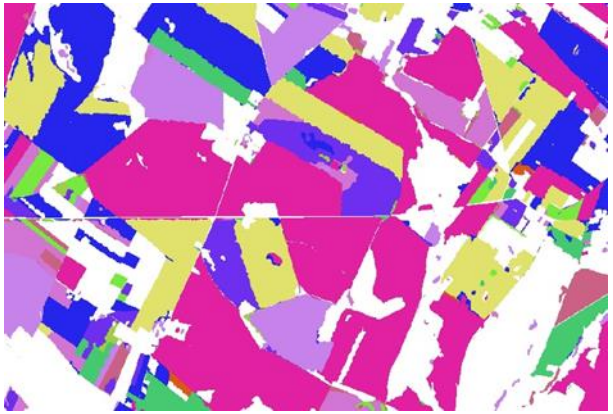




Estimated area of crops [ha]

System for estimating the crops area

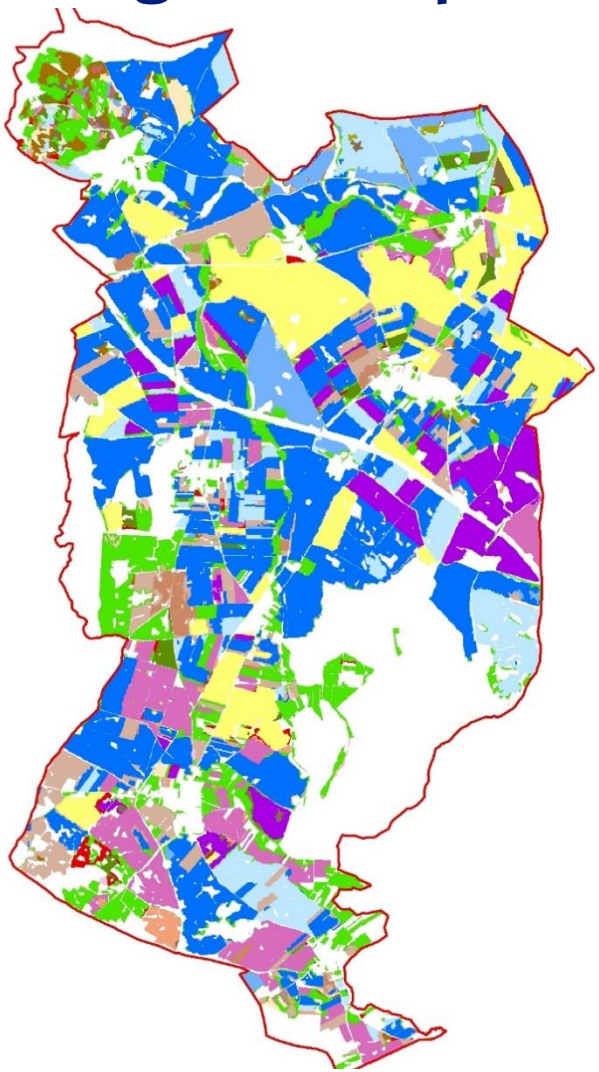




37 crops
OA = 78%

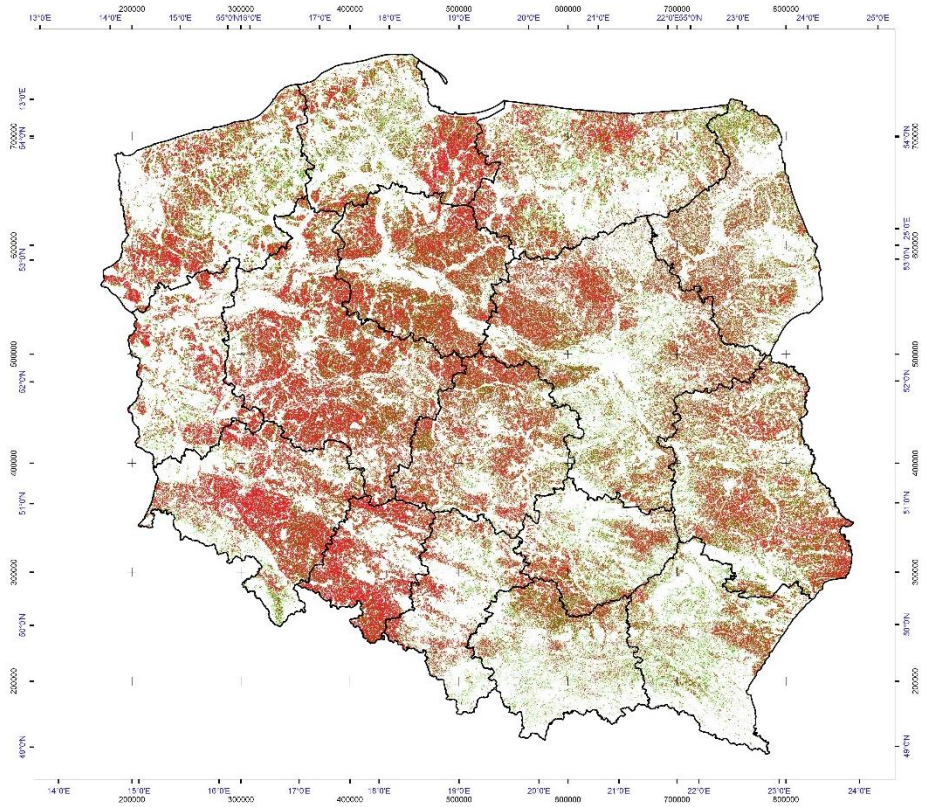
kod_pow	pow_nazwa	kod_gm	gm_nazw	buraki cukrowe	gorczyca
0201	Powiat bolesławiecki	0201011	Bolesławiec (1)	0,00	0,0
		0201022	Bolesławiec (2)	27,74	16,4
		0201032	Gromadka (2)	5,33	4,6
		0201043	Nowogrodziec (3)	4,02	20,7
		0201052	Osiecznica (2)	0,00	0,0
		0201062	Warta Bolesławiecka (2)	118,82	3,2
	Powiat bolesławiecki Suma			155,92	45,1
0202	Powiat dzierżoniowski	0202011	Bielawa (1)	21,21	1,8
		0202021	Dzierżoniów (1)	35,67	0,1
		0202033	Pieszyce (3)	38,55	3,4
		0202041	Piława Górna (1)	8,50	0,8
		0202052	Dzierżoniów (2)	332,82	18,8
		0202062	Łagiewniki (2)	471,32	7,9
		0202073	Niemcza (3)	240,91	0,6
	Powiat dzierżoniowski Suma			1 148,98	33,6

System for estimating the crops area



Crop classification map at LAU level

Winter crop area estimation (early spring)



- Time series march – april every year
- Sentinel-1/2
- Based on NDVI and sigma nought
- Object based image classification
- Random Forest ML algorithm
- Google Earth Engine, eCognition

Google Earth Engine

```
// Filter input collections by desired data range and region.
var criteria = ee.Filter.and(
    ee.Filter.bounds(region), ee.Filter.date(START_DATE, END_DATE));
s2Sr = s2Sr.filter(criteria).map(maskEdges);
s2Clouds = s2Clouds.filter(criteria);

print('s2Sr', s2Sr);

// Join S2 SR with cloud probability dataset to add cloud mask.
var s2SrWithCloudMask = ee.Join.saveFirst('cloud_mask').apply({
  primary: s2Sr,
  secondary: s2Clouds,
  condition:
      ee.Filter.equals({leftField: 'system:index', rightField: 'system:index'})
});

var s2CloudMasked =
    ee.ImageCollection(s2SrWithCloudMask).map(maskClouds).median();

```

GEE code sample

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System for estimating the crops area – cloud computing

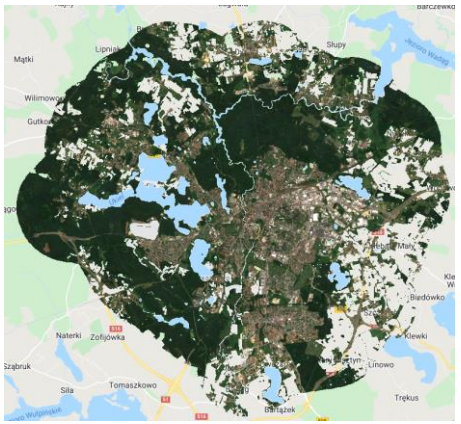
For research purposes we use **Google Earth Engine** cloud computing

- no need to download 30TB of data,
- no need to use workstations (saving energy and money),
- shortening the processing time from 2 months to about less than 1 week

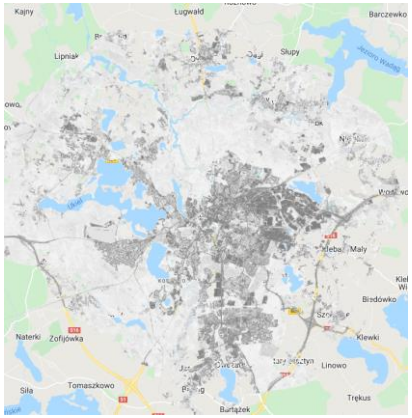
RGB Sentinel-2 mosaic

Sentinel-1 mosaic

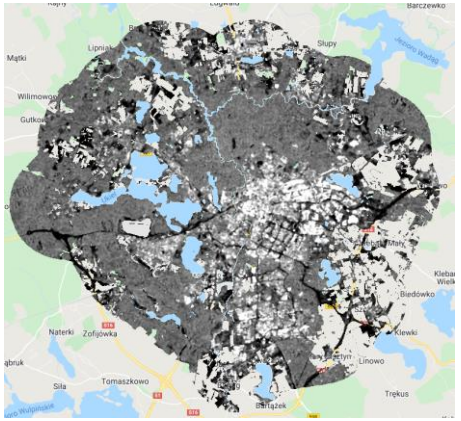
RGB Sentinel-2 mosaic masked



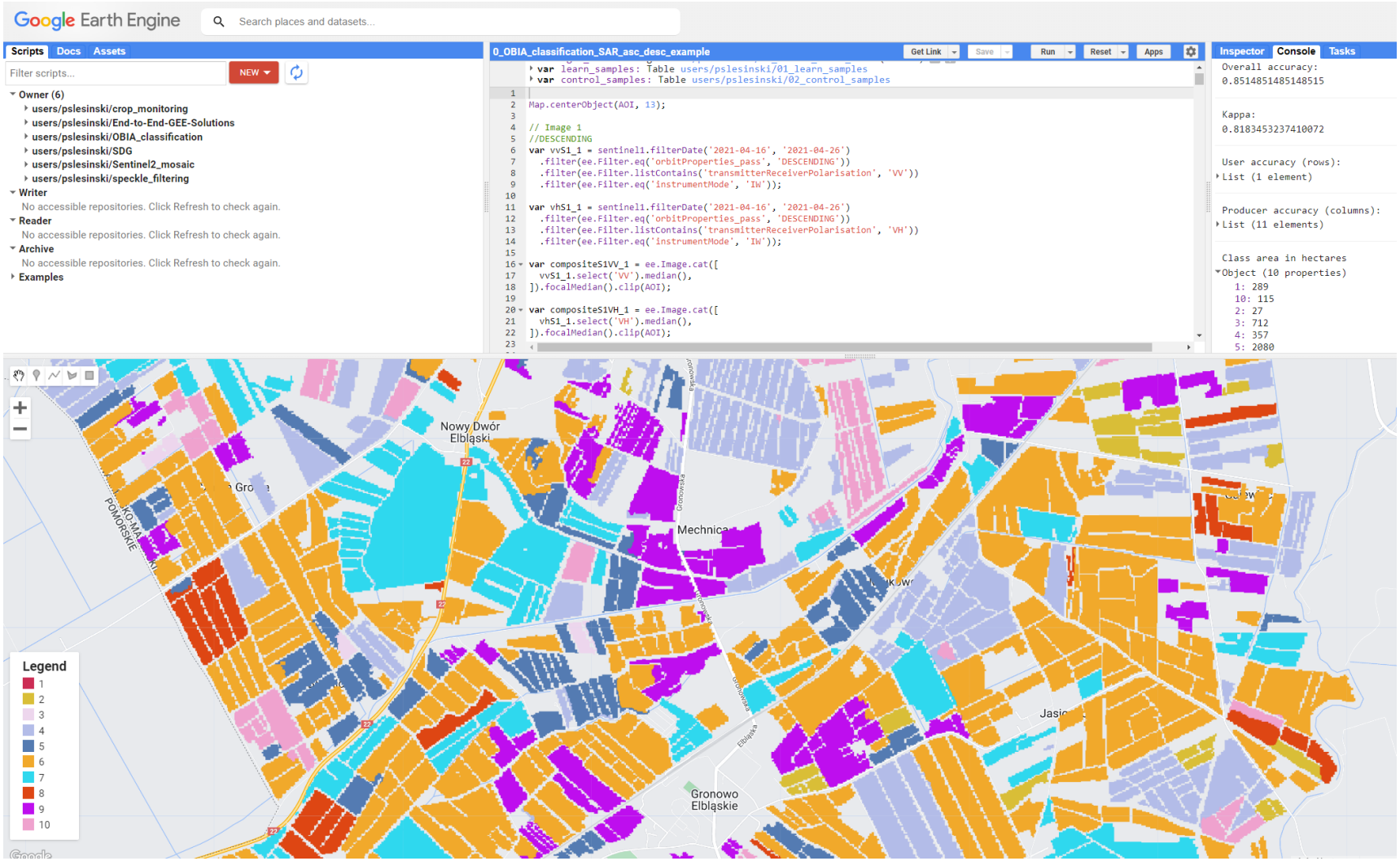
NDVI



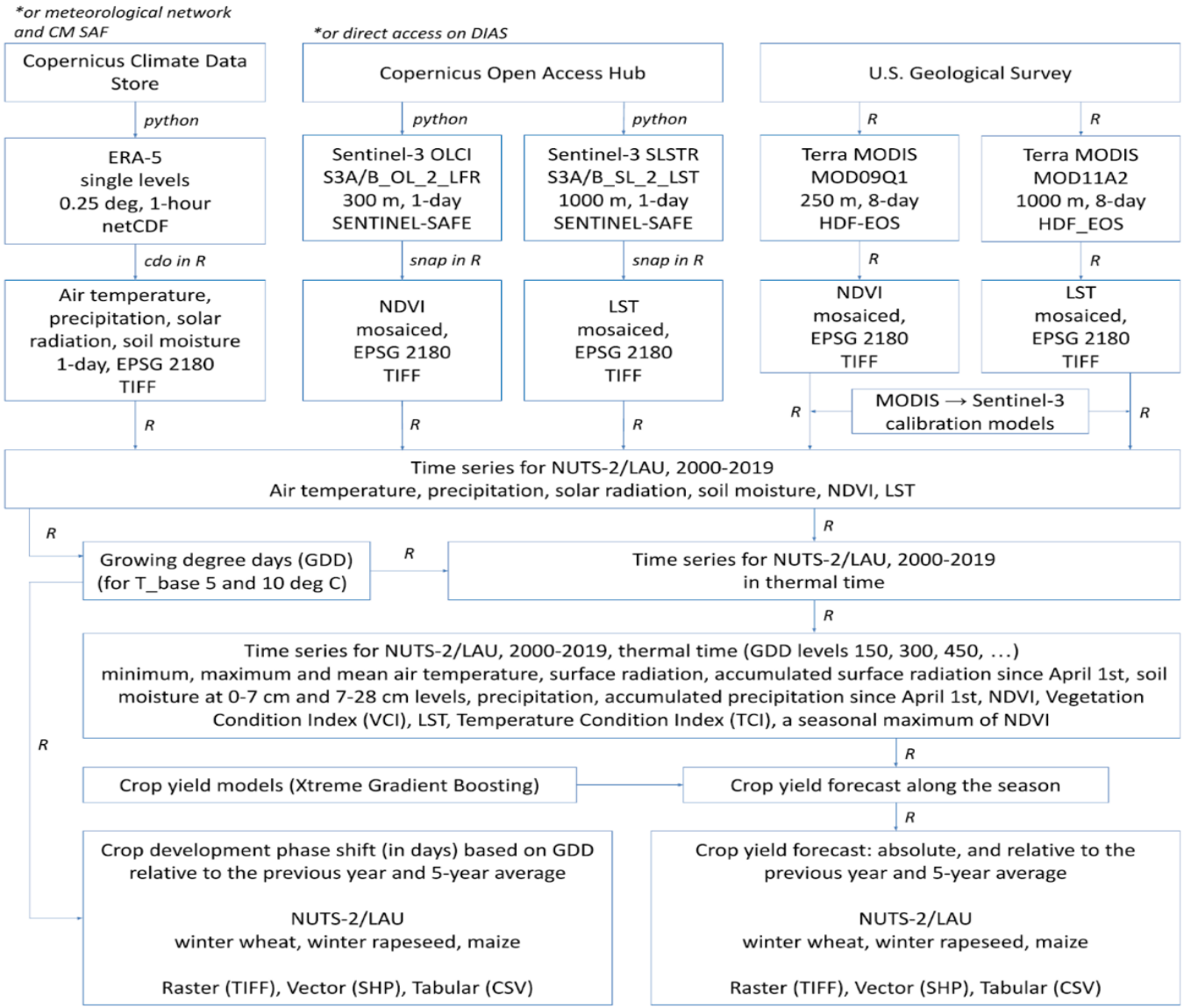
Sigma_0 S1



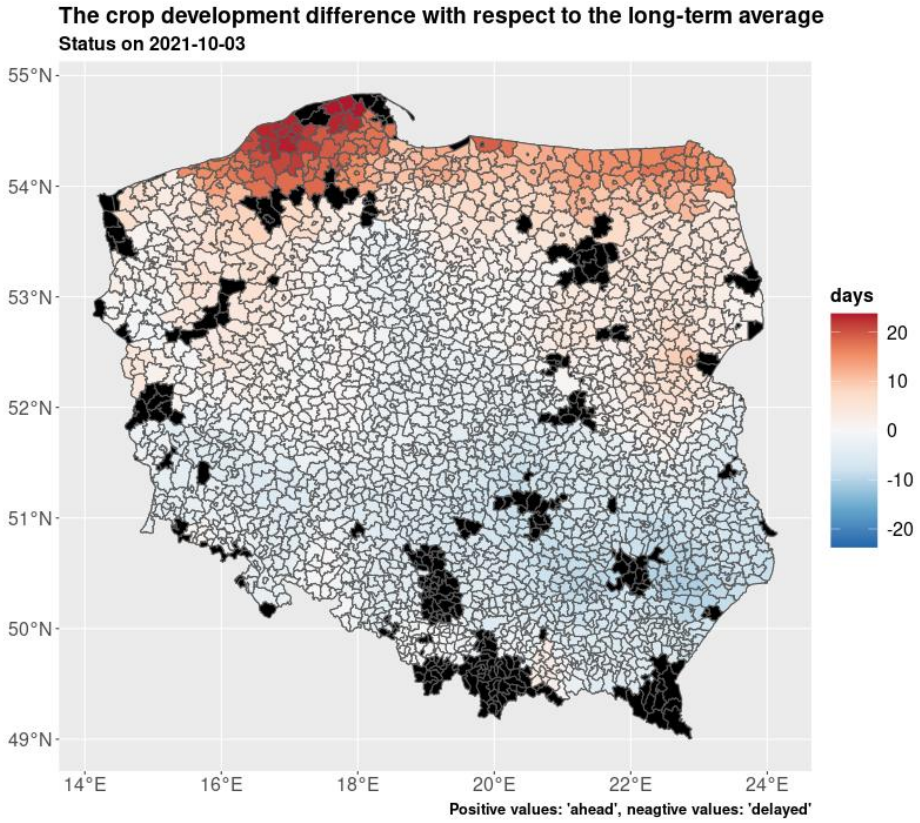
System for estimating the crops area – demo



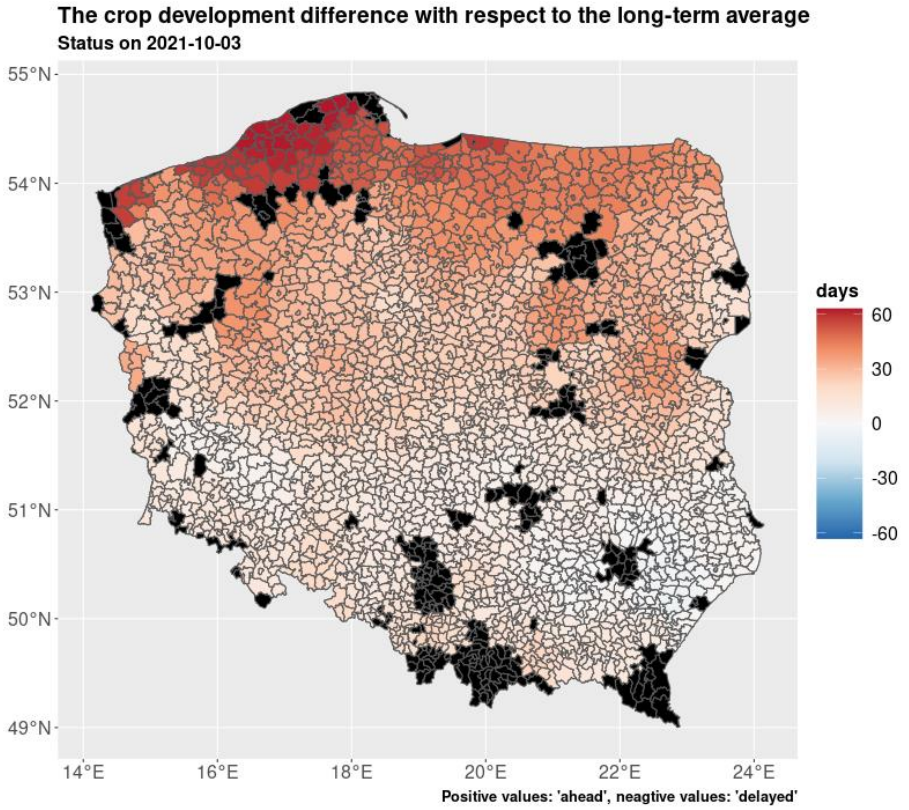
System for assessing the condition of crops and predicting yields



Crops condition module – final products at LAU units



winter rapeseed, winter wheat



maize

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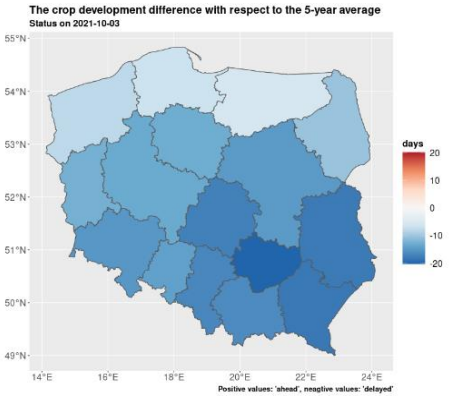
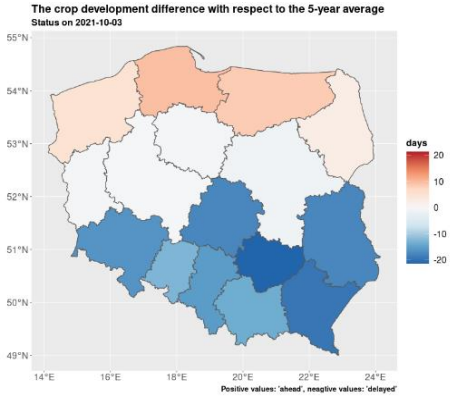
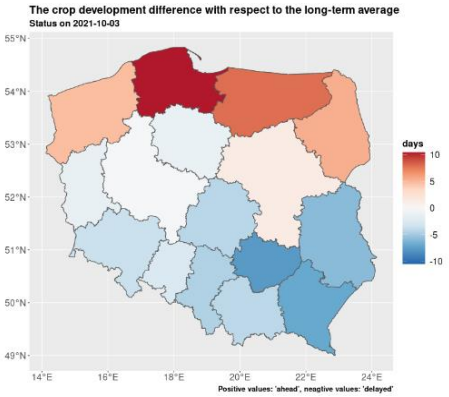
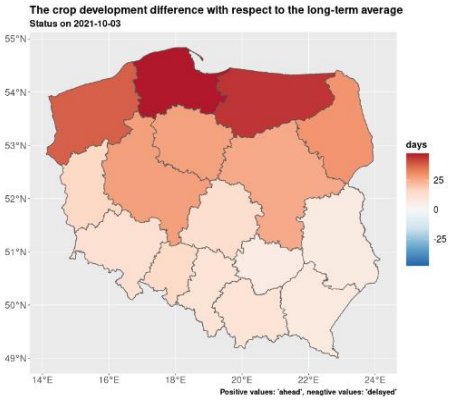
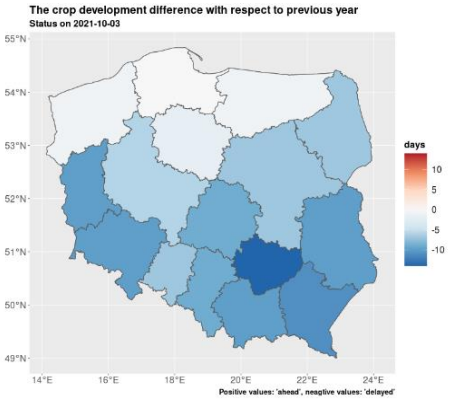
Crops condition module – final products at NUTS units

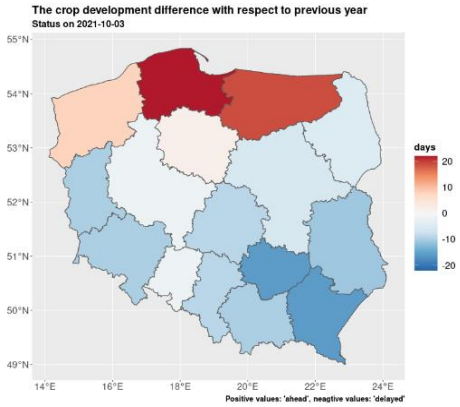












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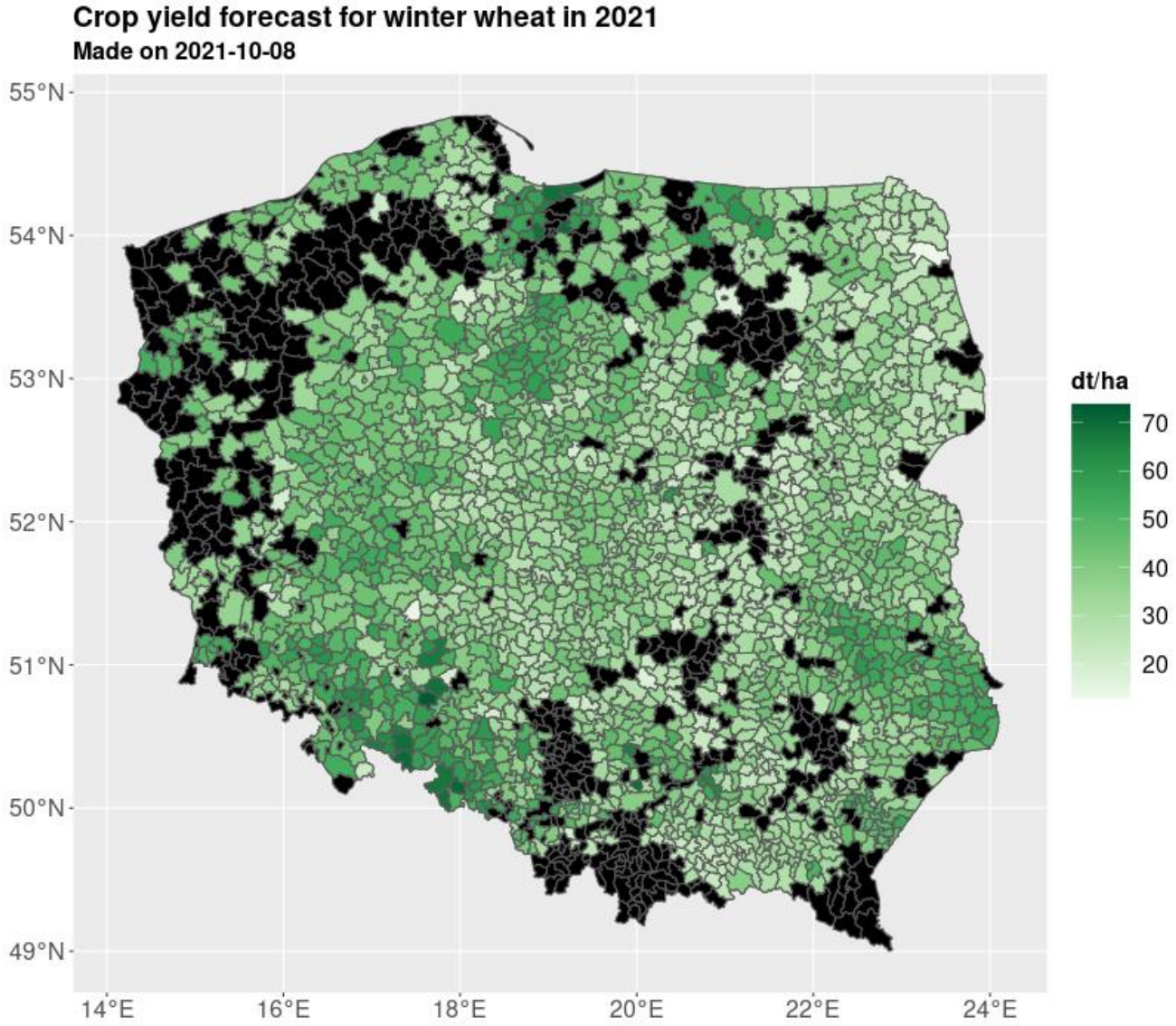
Yield prediction module – final products LAU units



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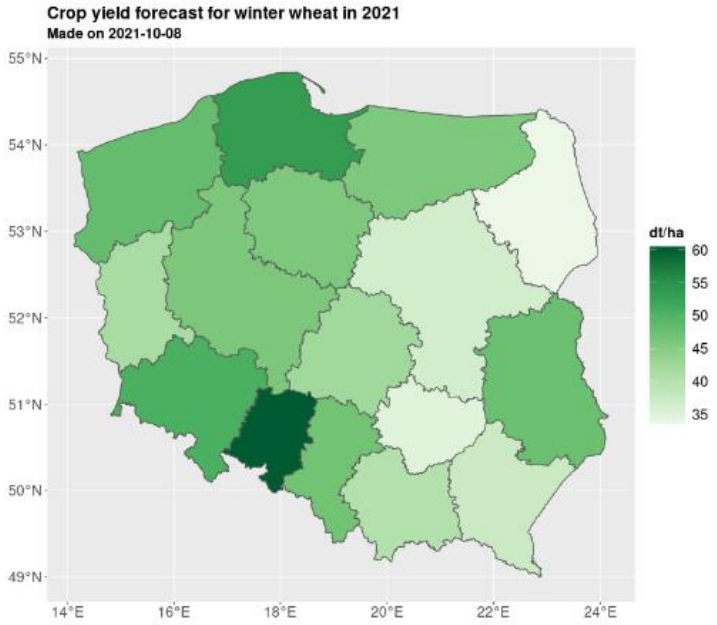
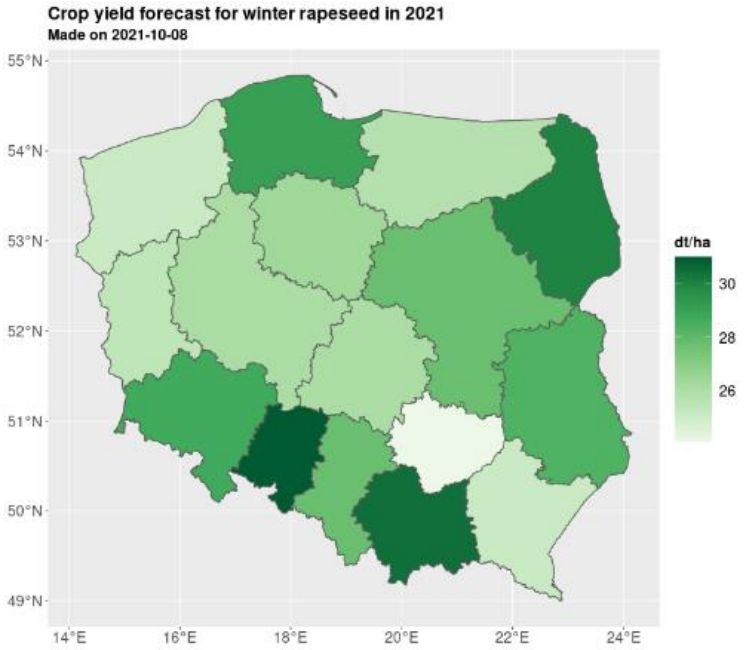
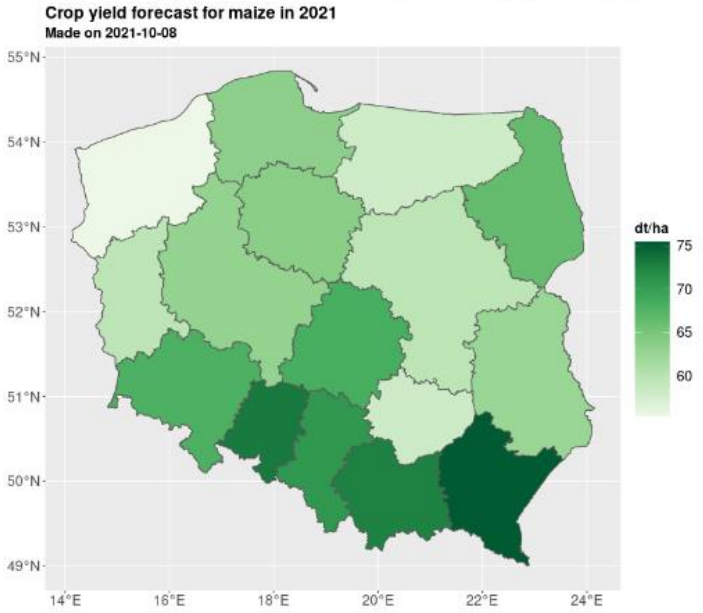
Yield prediction module – final products NUTS units

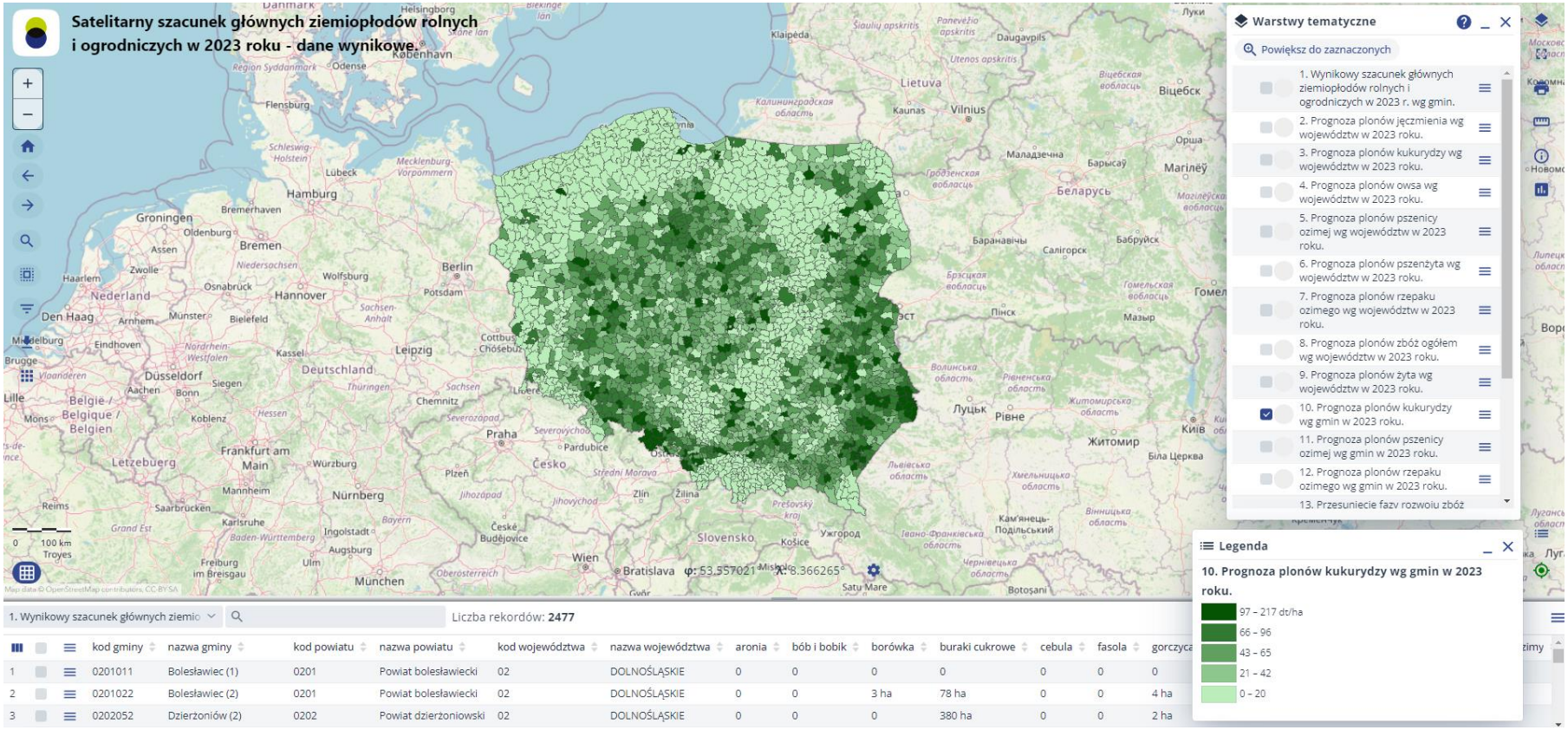




13 crop species – barley, maize, oat, rye, total cereals, winter triticale, winter rapeseed, winter wheat, mix spring cereals, pastures, permanent grassland, potatoes, sugar beets



Final products SATMIROL



All aggregated data for crops area and yield forecasting are available via Geostatistical Portal https://geo.stat.gov.pl/

SDG Goals – based on GIS and remote sensing methods

Indicator 9.1.1 Proportion of the rural population who live within 2 km of an all-season road

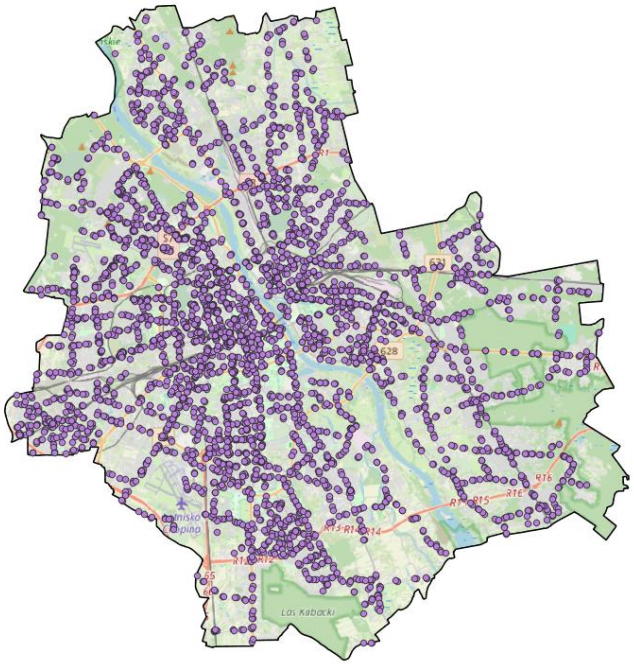
Indicator 11.3.1 - Ratio of land consumption rate to population growth rate

Indicator 11.2.1 - Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities

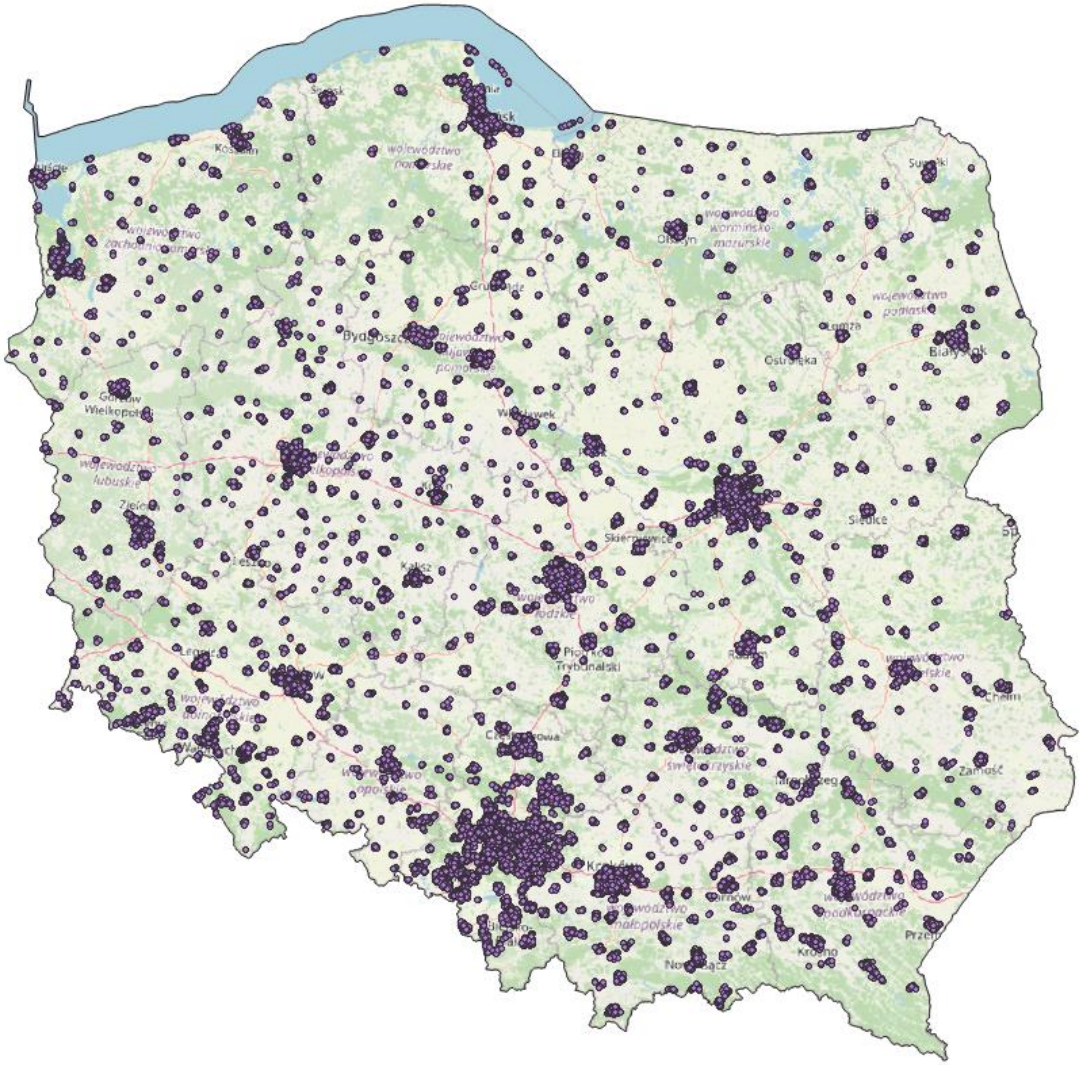
Indicator 11.7.1 - Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities

Indicator 11.2.1 - Methods

Public transport stops located in cities from the BDOT10k database.



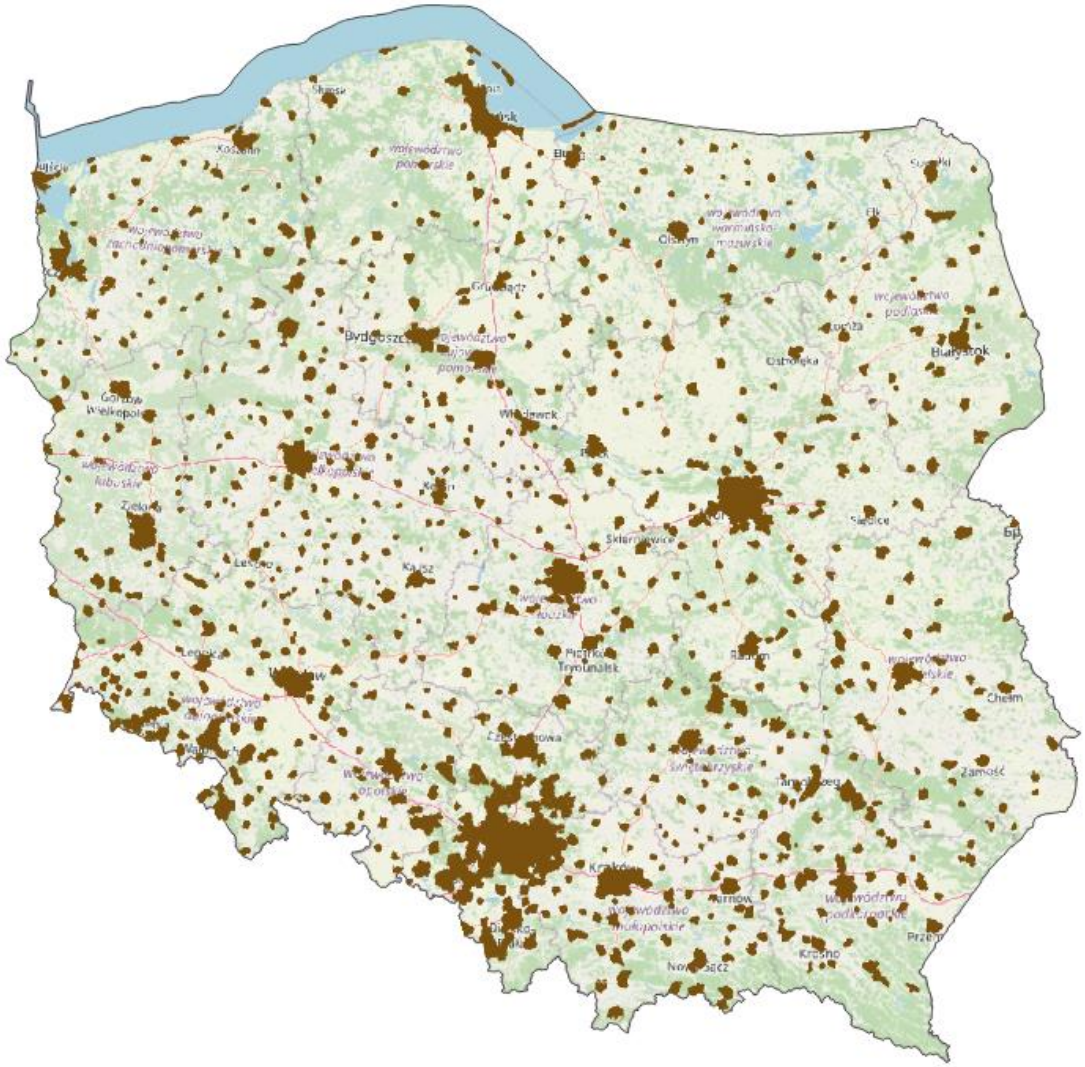
Warszawa



Indicator 11.2.1 - Methods

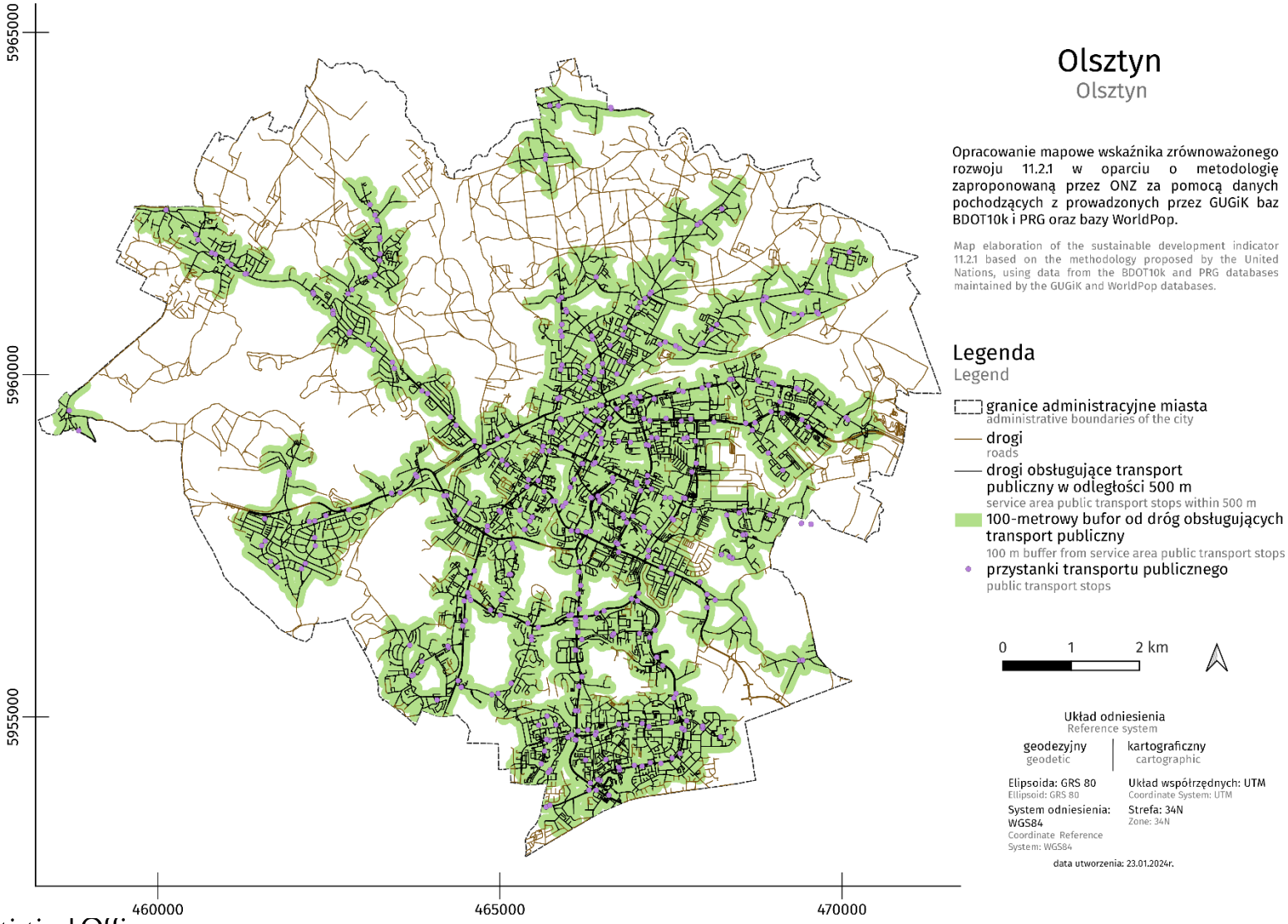
Network of roads in cities.

Warszawa



Indicator 11.2.1 - Methods

Spatial analysis of convenient access of the urban population to public transport by age and gender groups.



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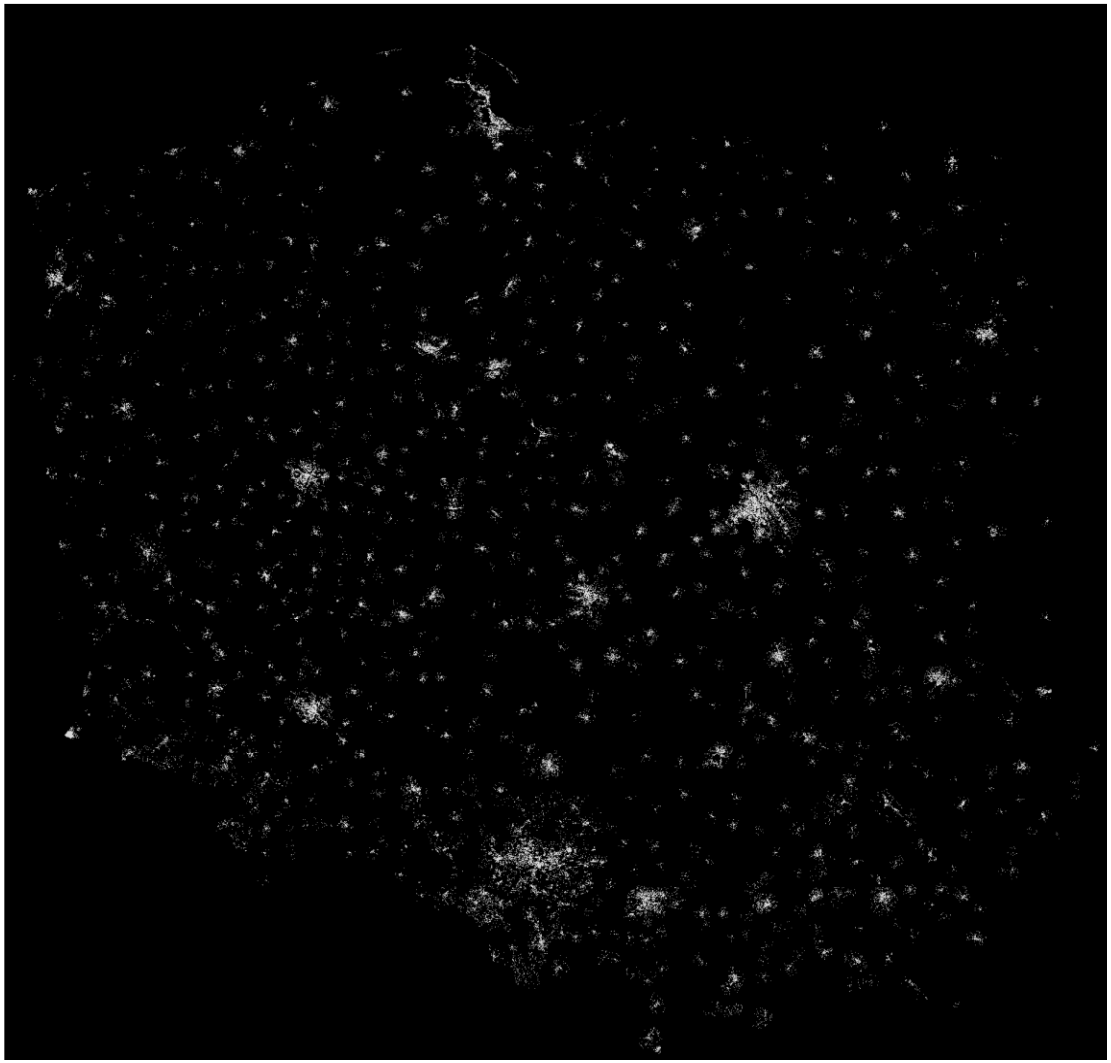
Indicator 11.3.1 - Methods

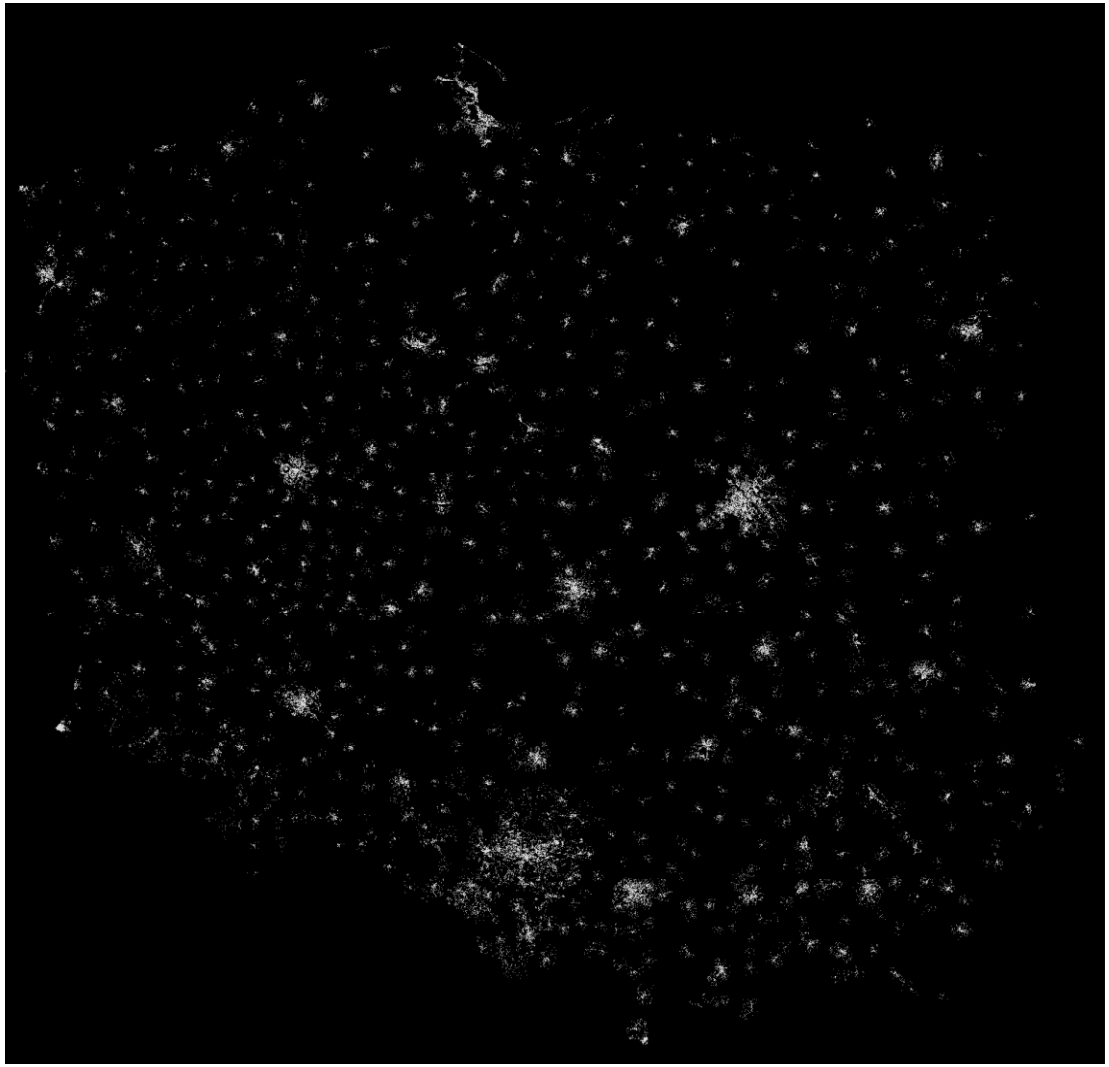
Implementation of object classification and development of maps built-up areas and calculation of their area for 2015 and 2020.



2015

Indicator 11.3.1 - Methods

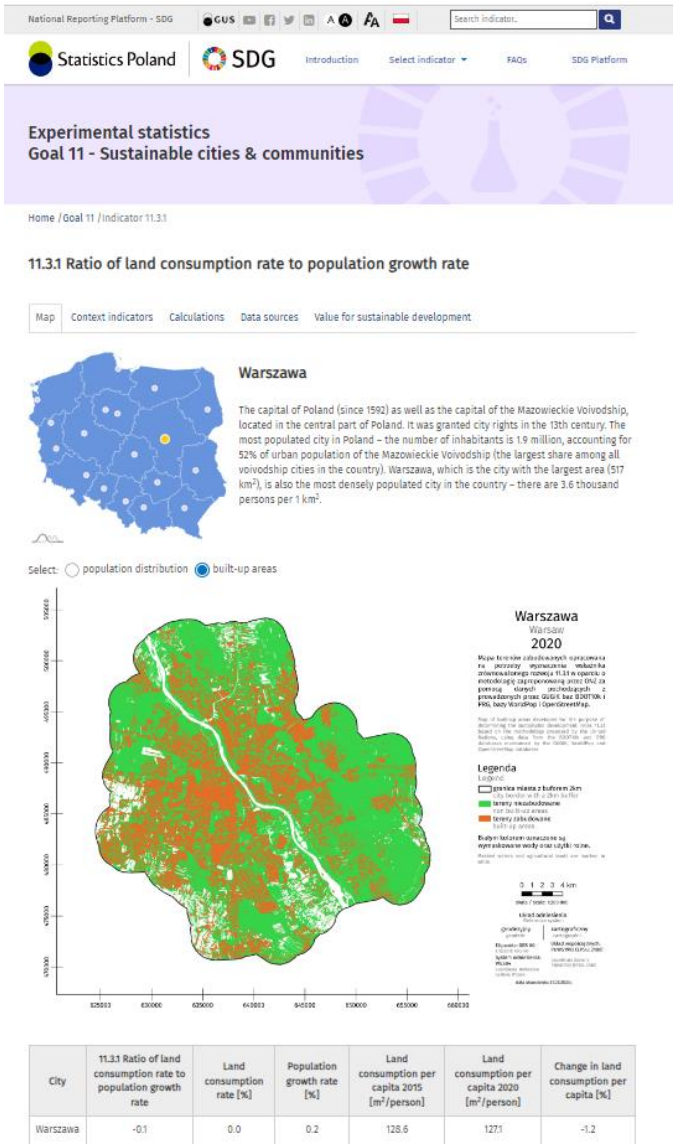
Implementation of object classification and development of maps built-up areas and calculation of their area for 2015 and 2020.

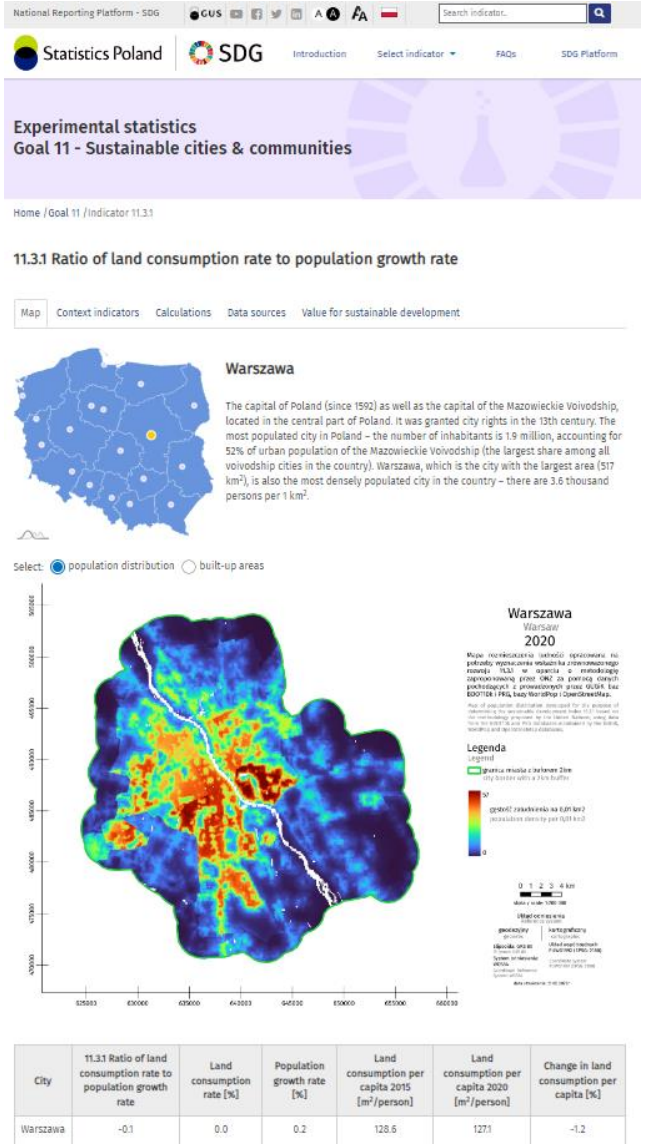


2020

SDG platform

All results for SDGs estimation data are available via experimental statistics portal https://sdg.gov.pl/statistics_exp/





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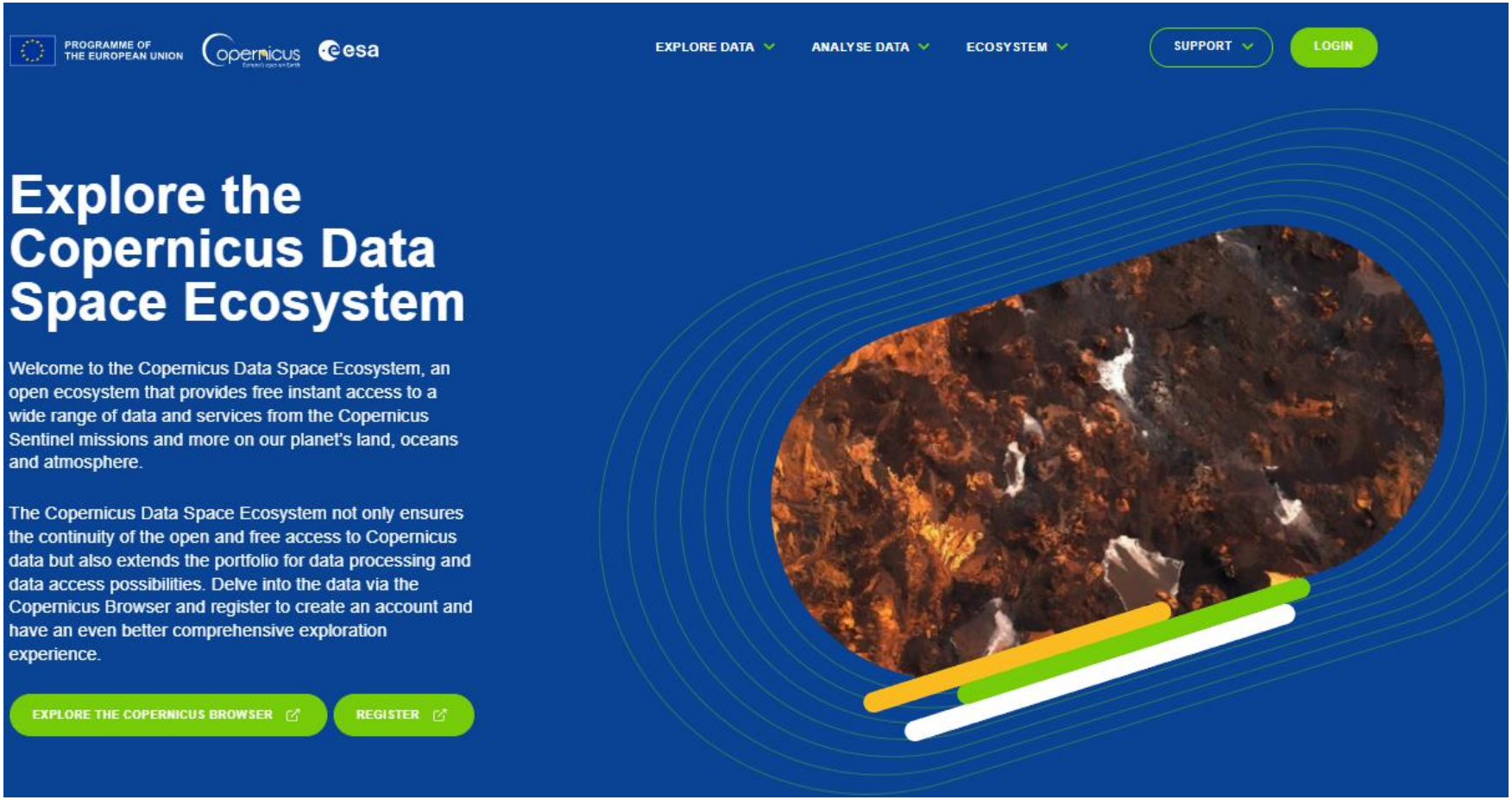
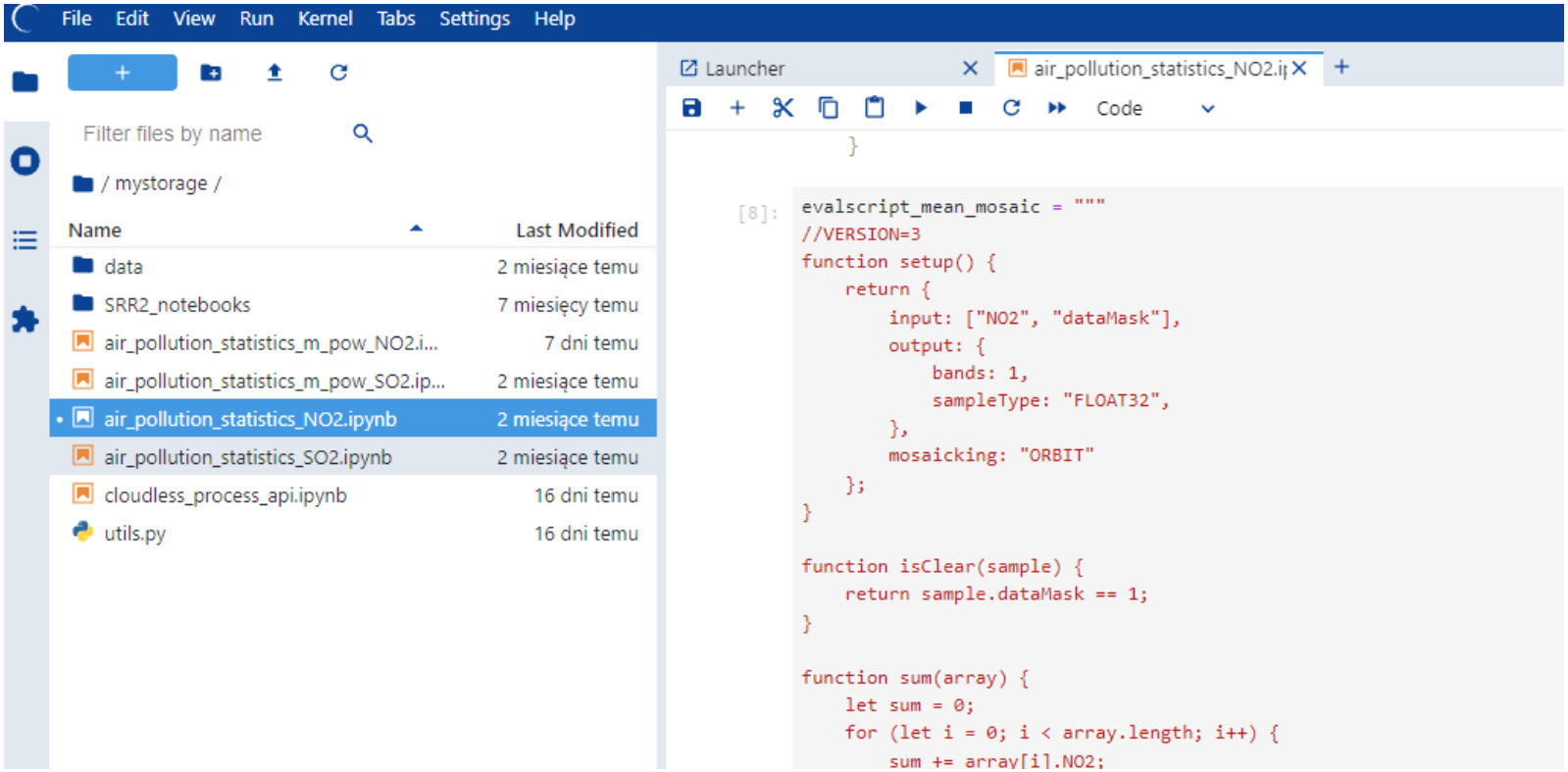
Air pollution statistics based on satellite data



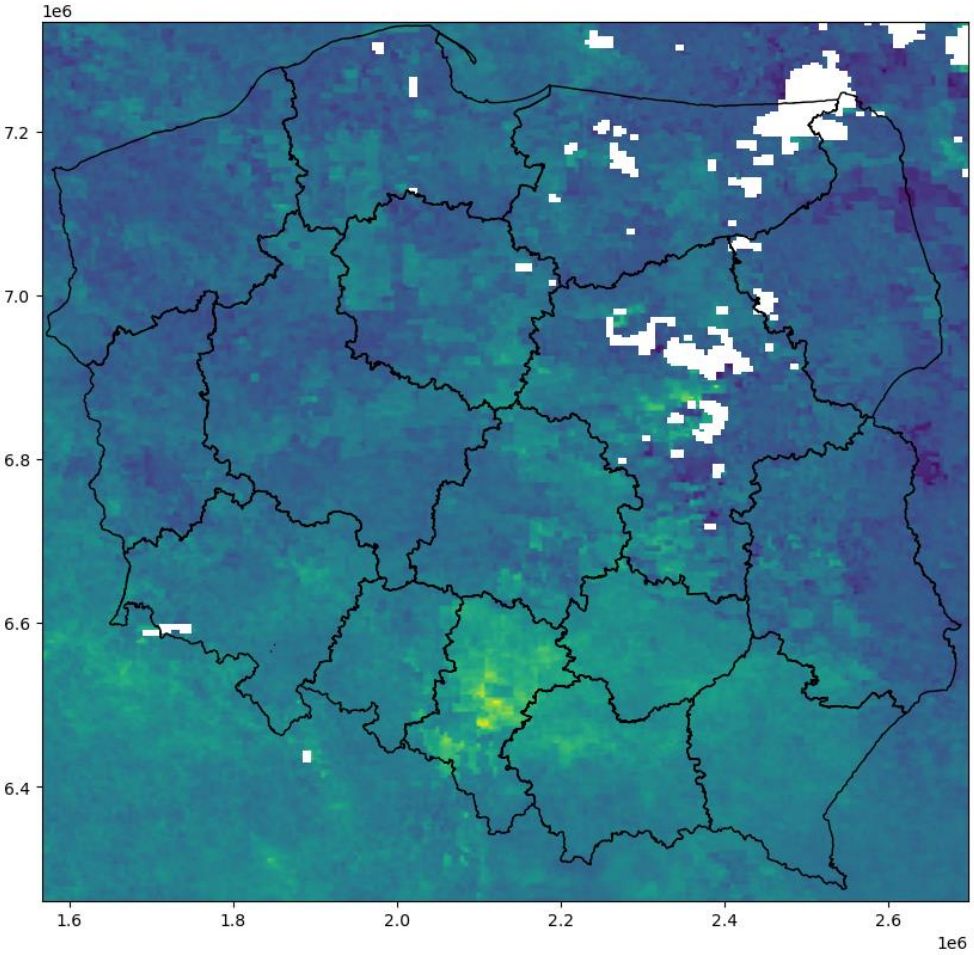
Copernicus Data Space Ecosystem - https://dataspace.copernicus.eu/

Air pollution statistics based on satellite data



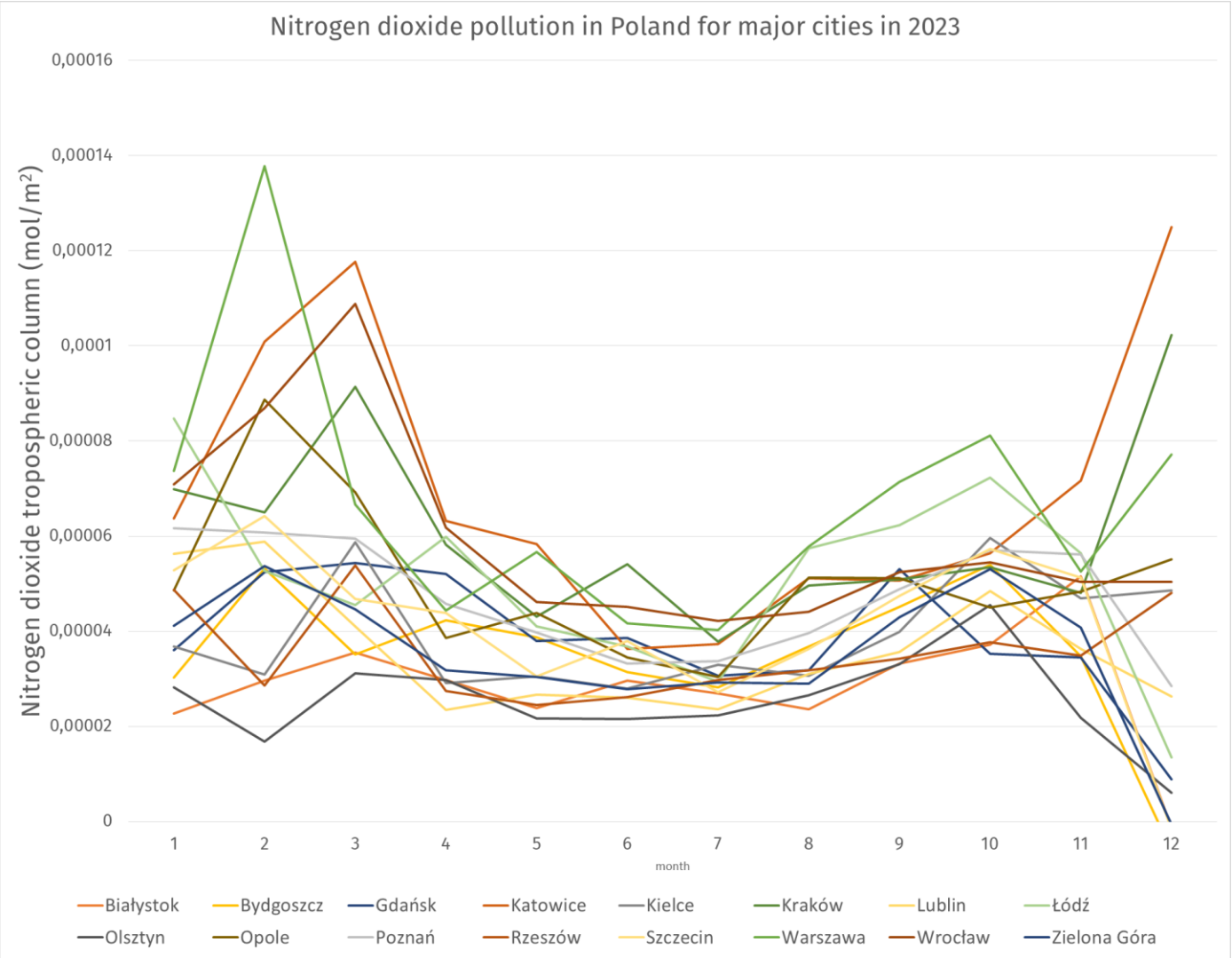
JupyterLab and cloud computing within Copernicus Data Space Ecosystem

Air pollution statistics based on satellite data (experimental)



Mean values of nitrogen dioxide for Poland in december 2023.
SENTINEL-5P

Air pollution statistics based on satellite data (experimental)



Mean monthly values of nitrogen dioxide for major cities in Poland in 2023.

Thank you for your attention