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# EuroCrops: The Creation of Pan-European Crop Dataset for Training and Testing

Ayshah Chan

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# How EuroCrops Started

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# Available Open Satellite Data

- Sentinel-2
  - Multi-spectral
  - Multi-temporal

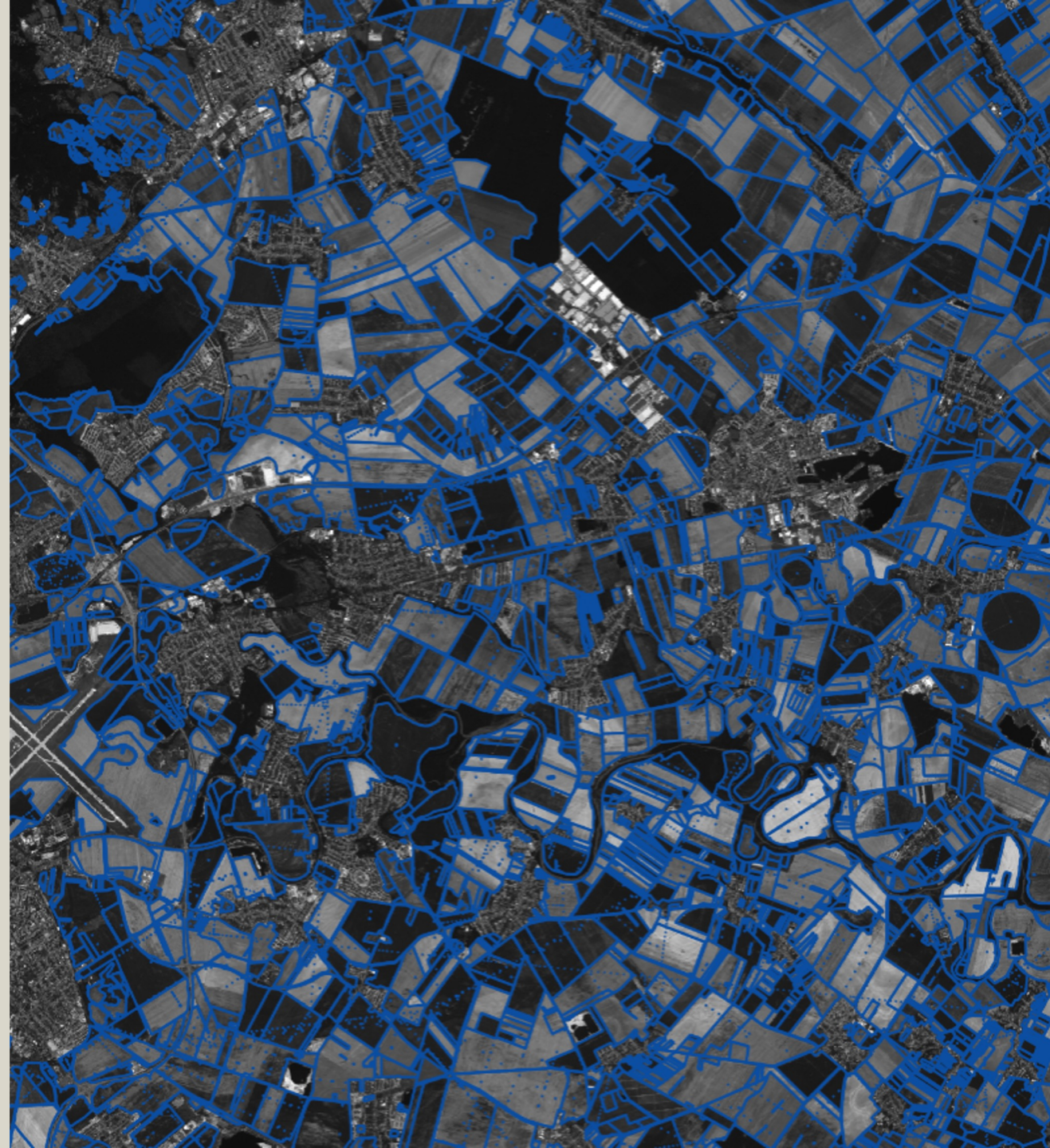




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# Available Open Reference Data

- Farmers' **self-declarations** *reliably* collected in the course of EU subsidy control
- Shapefiles (or similar) including the **geo-referenced crop field polygon** and at least one **crop** (“label”) growing there during a given year



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# EuroCrops Workflow

# Excerpts from Collected Data

OSA_ID	OSA_AREA	PAR_ID	EC_org_n
228.000000...	1636.000000...	8999173.000000...	MILHO
363.000000...	286.000000...	9000369.000000...	AVEIA
372.000000...	2446.000000...	9000438.000000...	VINHA
399.000000...	935.000000...	8998747.000000...	OUTRAS HORTÍCOLAS
468.000000...	458.000000...	8998275.000000...	CONSOCIAÇÕES ANUAIS E OUTRAS CULT.FORRAG.ANUAIS
507.000000...	937.000000...	9000241.000000...	CONSOCIAÇÕES ANUAIS E OUTRAS CULT.FORRAG.ANUAIS
549.000000...	630.000000...	8999700.000000...	PRADOS TEMPORÁRIOS

Portugal

KZS_NR	DKL_PLOTAS	GRUPE	NMA_ID	Shape_Leng	Shape_Area
218411-9186	0.35	Ganyklos-pievos virð 5m.	2004877	295.295779502...	3555.787419 ...
220411-0109	1.94000000...	Ganyklos-pievos virð 5m.	2004877	680.729432590 ...	19434.87467 ...
219412-0502	0.5	Grikliai	2004877	282.44425668 ...	5000.52770 ...
127372-9074	2.09000000...	Ankðtiniai javai	2001917	741.404924189 ...	20924.2880 ...
127372-2411	1.03000000...	Darþovės	2001917	495.818636755 ...	10374.50000 ...
077520-0864	8.48000000...	Ganyklos-pievos virð 5m.	1978317	1619.89021303 ...	84834.3022 ...
048513-9660	6.28000000...	Ganyklos-pievos virð 5m.	1978317	1129.55373226 ...	62849.5009 ...
229360-7056	0.93	Aviþpos	2006693	478.759049745 ...	9350.27513 ...

Lithuania



## Excerpts from Collected Data

OSA_ID	OSA_AREA	PAR_ID	EC_org_n	EC_trans_n
228.000000...	1636.000000...	8999173.000000...	MILHO	CORN
363.000000...	286.000000...	9000369.000000...	AVEIA	OAT
372.000000...	2446.000000...	9000438.000000...	VINHA	VINEYARD
399.000000...	935.000000...	8998747.000000...	OUTRAS HORTÍCOLAS	OTHER VEGETABLES
468.000000...	458.000000...	8998275.000000...	CONSOCIAÇÕES ANUAIS E OUTRAS CULT.FORRAG.ANUAIS	ANNUAL AND OTHER CULT.FORAGE ANNUALS
507.000000...	937.000000...	9000241.000000...	CONSOCIAÇÕES ANUAIS E OUTRAS CULT.FORRAG.ANUAIS	ANNUAL AND OTHER CULT.FORAGE ANNUALS
549.000000...	630.000000...	8999700.000000...	PRADOS TEMPORÁRIOS	TEMPORARY MEADOWS

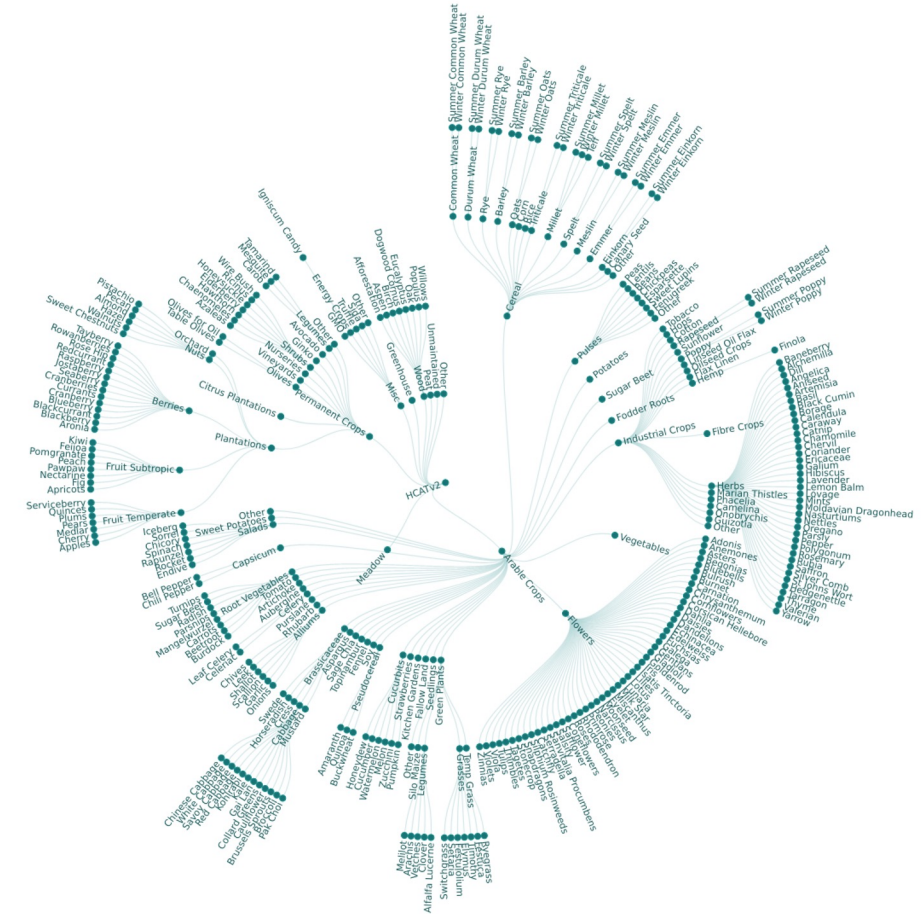
Portugal

KZS_NR	DKL_PLOTAS	GRUPE	NMA_ID	Shape_Leng	Shape_Area	EC_trans_n
218411-9186	0.35	Ganyklos-pievos virð 5m.	2004877	295.295779502...	3555.787419...	Pastures-meadows over 5m.
220411-0109	1.94000000...	Ganyklos-pievos virð 5m.	2004877	680.729432590...	19434.87467...	Pastures-meadows over 5m.
219412-0502	0.5	Grikiai	2004877	282.44425668...	5000.52770...	Buckwheat
127372-9074	2.09000000...	Ankðtiniai javai	2001917	741.404924189...	20924.2880...	Early cereals
127372-2411	1.03000000...	Darðovës	2001917	495.818636755...	10374.50000...	Vegetables
077520-0864	8.48000000...	Ganyklos-pievos virð 5m.	1978317	1619.89021303...	84834.3022...	Pastures-meadows over 5m.
048513-9660	6.28000000...	Ganyklos-pievos virð 5m.	1978317	1129.55373226...	62849.5009...	Pastures-meadows over 5m.
229360-7056	0.93	Aviþpos	2006693	478.759049745...	9350.27513...	Oats

Lithuania

# Hierarchical Crop and Agriculture Taxonomy (HCAT)

- Based on
  - EU regulations
  - EAGLE matrix (European Environment Agency)
- 6-level hierarchy
- Any granularity can be reflected and stored



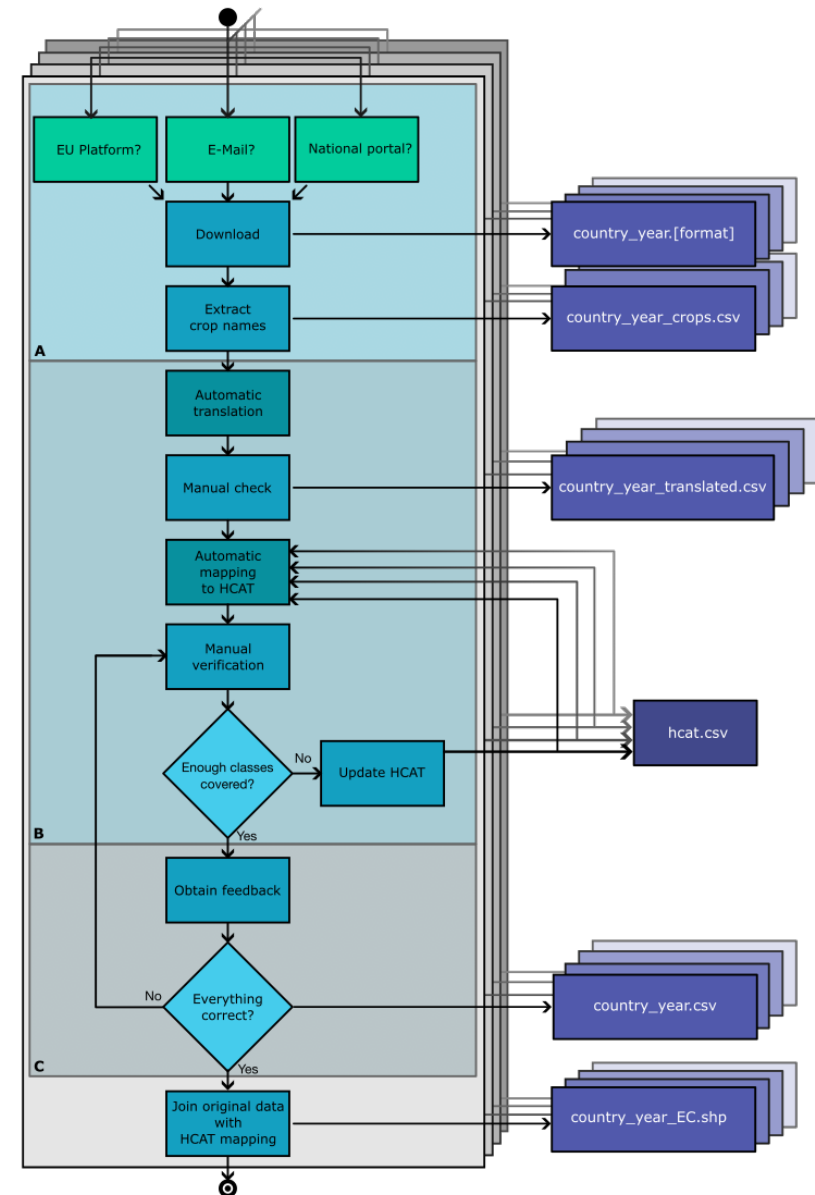


# Harmonised Data 2021

OSA_ID	OSA_AREA	PAR_ID	EC_org_n	EC_trans_n	EC_hcat_n	EC_hcat_c
228.000000...	1636.00000...	8999173.00000...	MILHO	CORN	grain_maize_corn_popcorn	3301010600
363.000000...	286.000000...	9000369.00000...	AVEIA	OAT	oats	3301010500
372.000000...	2446.00000...	9000438.00000...	VINHA	VINEYARD	vineyards_wine_vine_rebland_grapes	3303060000
399.000000...	935.000000...	8998747.00000...	OUTRAS HORTÍCOLAS	OTHER VEGETABLES	fresh_vegetables	3301070000
468.000000...	458.000000...	8998275.00000...	CONSOCIAÇÕES ANUAIS E OUTRAS CULT.FORRAG.ANUAIS	ANNUAL AND OTHER CULT.FORAGE ANNUALS	other_arable_land_crops	3301990000
507.000000...	937.000000...	9000241.00000...	CONSOCIAÇÕES ANUAIS E OUTRAS CULT.FORRAG.ANUAIS	ANNUAL AND OTHER CULT.FORAGE ANNUALS	other_arable_land_crops	3301990000
549.000000...	630.000000...	8999700.00000...	PRADOS TEMPORÁRIOS	TEMPORARY MEADOWS	temporary_grass	3301090100

KZS_NR	DKL_PLOTAS	GRUPE	NMA_ID	Shape_Leng	Shape_Area	EC_trans_n	EC_hcat_n	EC_hcat_c
218411-9186	0.35	Ganyklos-pievos virð 5m.	2004877	295.295779502...	3555.787419...	Pastures-meadows over 5m.	pasture_meadow_grassland_grass	3302000000
220411-0109	1.94000000...	Ganyklos-pievos virð 5m.	2004877	680.729432590...	19434.87467...	Pastures-meadows over 5m.	pasture_meadow_grassland_grass	3302000000
219412-0502	0.5	Grikiai	2004877	282.44425668...	5000.52770...	Buckwheat	buckwheat	3301150200
127372-9074	2.09000000...	Ankðtiniai javai	2001917	741.404924189...	20924.2880...	Early cereals	spring_unspecified_cereals	3301011502
127372-2411	1.03000000...	Darþovēs	2001917	495.818636755...	10374.50000...	Vegetables	fresh_vegetables	3301070000
077520-0864	8.48000000...	Ganyklos-pievos virð 5m.	1978317	1619.89021303...	84834.3022...	Pastures-meadows over 5m.	pasture_meadow_grassland_grass	3302000000
048513-9660	6.28000000...	Ganyklos-pievos virð 5m.	1978317	1129.55373226...	62849.5009...	Pastures-meadows over 5m.	pasture_meadow_grassland_grass	3302000000
229360-7056	0.93	Aviþos	2006693	478.759049745...	9350.27513...	Oats	oats	3301010500

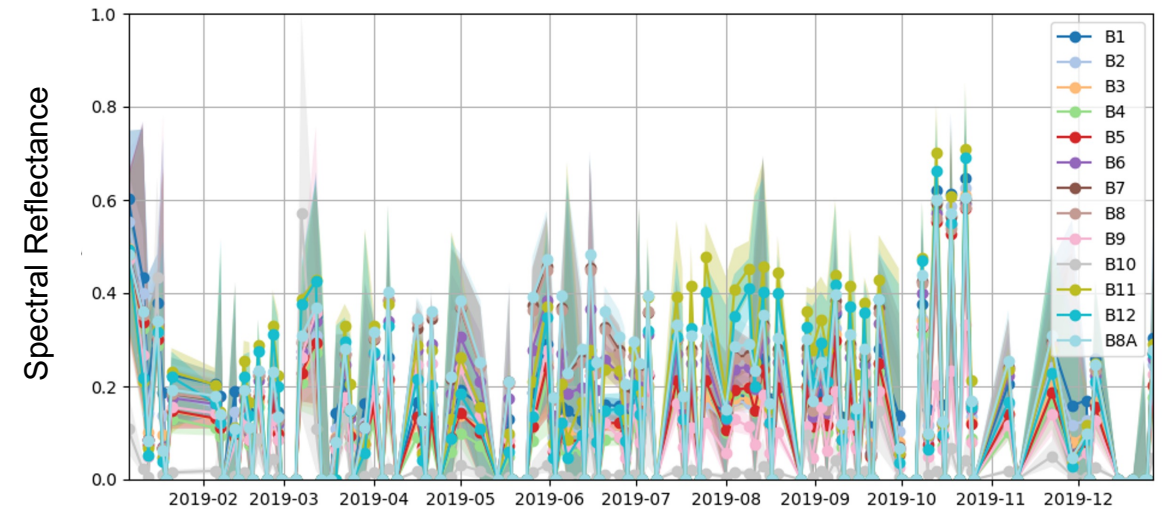
# EuroCrops Pipeline



# Combining Satellite and Reference Data

- Synchronizing Coordinate Reference System
- Matching Crop Polygons to Sentinel-2 Tiles
- Extracting Spectral Reflectances for corresponding polygons

Sample Winter Wheat Spectral Reflectance



# Using EO-Lab for EuroCrops

- Data Locations
  - EuroCrops  
/eolab/training-data/EuroCrops
  - Sentinel 2 L1C tiles  
/codede/Sentinel-2/MSI/L1C

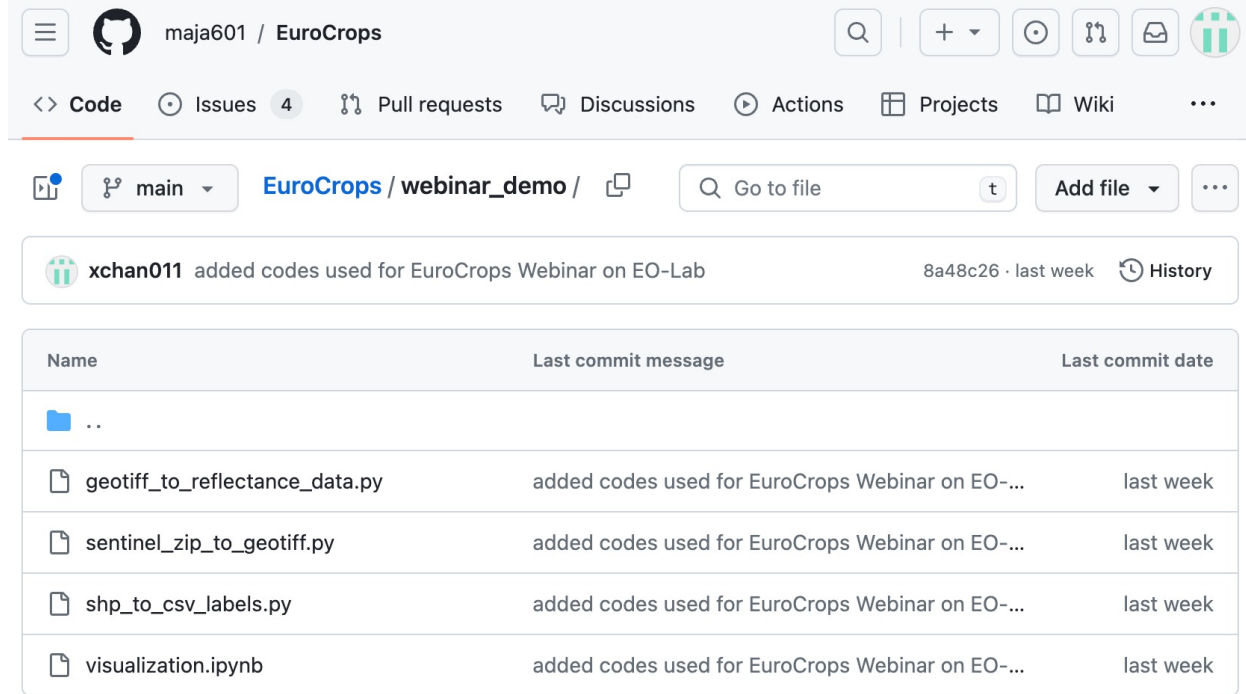
```
eouser@ayshah-vm:/eolab/training-data/EuroCrops$ ls
AT_2021.zip      EE_2021.zip      LV_2021.zip      SI.zip
BE_VLG_2021.zip ES_NA_2020.zip   NL_2021.zip      SK_2021.zip
DE_LS_2021.zip  FR_2018.zip      PT.zip
DE_NRW_2021.zip HR_2020.zip      RO_ny.zip
DK_2019.zip     LT_2021.zip      SE_2021.zip
eouser@ayshah-vm:/eolab/training-data/EuroCrops$ █

eouser@ayshah-vm:/codede/Sentinel-2/MSI/L1C$ ls
2015 2016 2017 2018 2019 2020 2021 2022 2023
eouser@ayshah-vm:/codede/Sentinel-2/MSI/L1C$ ls 2021
01 02 03 04 05 06 07 08 09 10 11 12
eouser@ayshah-vm:/codede/Sentinel-2/MSI/L1C$ ls 2021/08
01 04 07 10 13 16 19 22 25 28 31
02 05 08 11 14 17 20 23 26 29
03 06 09 12 15 18 21 24 27 30
eouser@ayshah-vm:/codede/Sentinel-2/MSI/L1C$ ls 2021/08/21
S2A_MSIL1C_20210821T101031_N0301_R022_T32TNS_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32TNT_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32TPS_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32TPT_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32TQS_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32TQT_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32UPA_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32UPB_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32UPU_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32UPV_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32UQA_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32UQB_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32UQC_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32UQD_20210821T110829.SAFE
S2A_MSIL1C_20210821T101031_N0301_R022_T32UQE_20210821T110829.SAFE
```



# Tutorials Available for EuroCrops

<https://github.com/maja601/EuroCrops>



maja601 / EuroCrops

Code Issues 4 Pull requests Discussions Actions Projects Wiki

main EuroCrops / webinar\_demo / Go to file Add file

xchan011 added codes used for EuroCrops Webinar on EO-Lab 8a48c26 · last week History

Name	Last commit message	Last commit date
..		
geotiff_to_reflectance_data.py	added codes used for EuroCrops Webinar on EO-...	last week
sentinel_zip_to_geotiff.py	added codes used for EuroCrops Webinar on EO-...	last week
shp_to_csv_labels.py	added codes used for EuroCrops Webinar on EO-...	last week
visualization.ipynb	added codes used for EuroCrops Webinar on EO-...	last week

## EuroCrops Demo

Created by: Maja Schneider

Updated by: Cyrille Médard de Chardon & Alex Skinner

This notebook assists with exploring the EuroCrops demo datasets.

It mainly covers how to load/open HDF (version 5 -> HDF5) data and how to select individual data bands and time series.

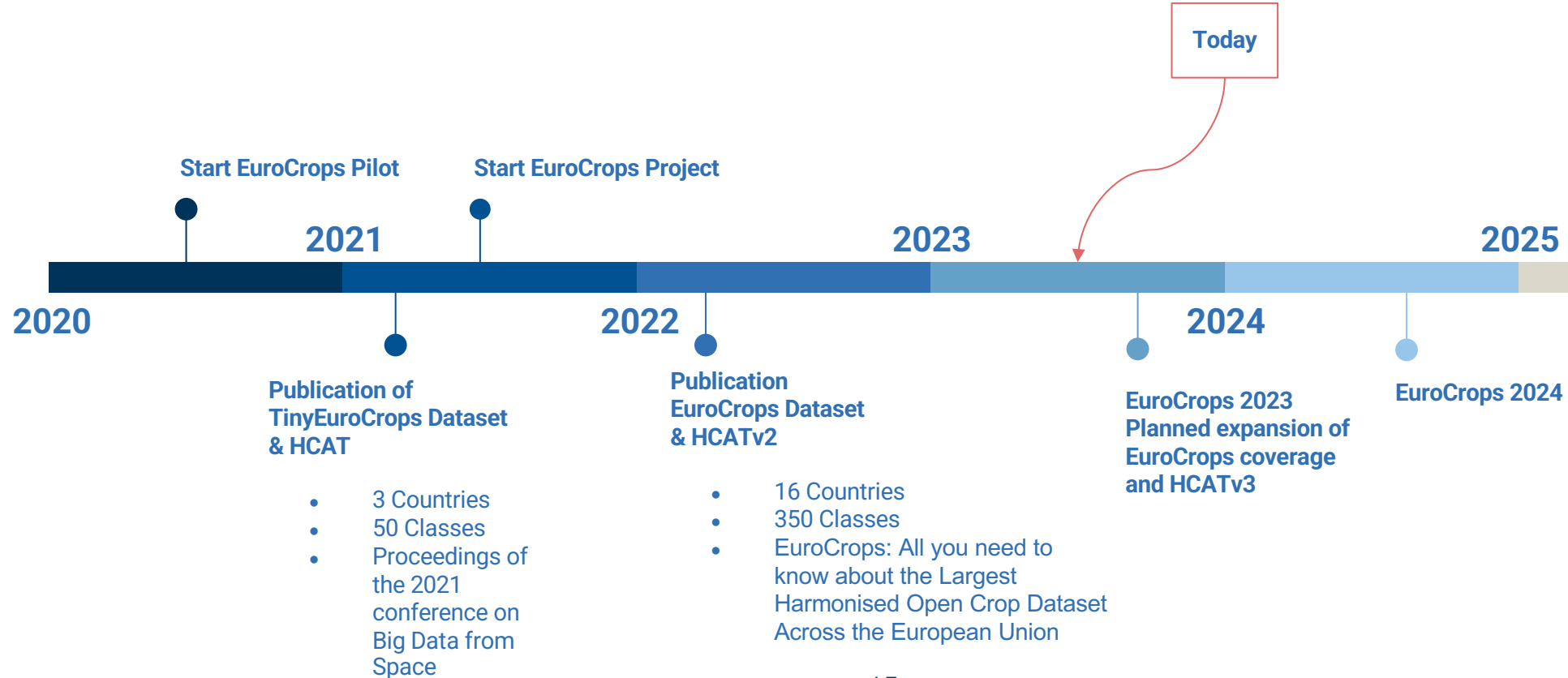
This resource does not describe how to perform Time Series Classification (TSC) through Pixel Set Encoding (PSE) and Temporal Attention Encoding (TAE), only how to access the HDF data that would be inputs for those processes.

For more information on TSC applications for crop types see [Schneider and Körner \(2021\)](#).

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# Current Status

# Timeline





- [Changes in the general taxonomy + error correction for FR/NL](#)  
#18 by valbarriere was merged last month
- [Changes in the general taxonomy + error correction for FR/NL](#)  
#17 by valbarriere was closed last month
- [Bugfix: NL data is from 2020](#)  
#16 by kvantricht was merged on Dec 13, 2022
- [updated tutorial](#)  
#15 by serialc was merged on Dec 5, 2022
- [harmonization of spring crops codes](#)  
#14 by Martincccc was merged on Nov 16, 2022
- [spring wheat code](#)  
#13 opened on Sep 23, 2022 by Martincccc
- [Drop Z dimension](#)  
#11 opened on Jul 8, 2022 by thomasstorm
- [update sk and nl](#)  
#10 by Martincccc was merged on Jul 6, 2022
- [SK winter soft wheat](#)  
#9 by Martincccc was closed on Jul 20, 2022
- [RO, HR, ES\\_NA with Land Use and not crop types](#)  
#8 opened on Jun 29, 2022 by Martincccc
- [Crop HCAT2 classification issues](#)  
#7 by sbgeophd was closed on Jul 20, 2022
- [Data quality and quality assurance of agricultural parcel](#)  
#6 opened on Jun 10, 2022 by sumesh1
- [Change summer\\_oats to spring\\_oats in dk\\_2019.csv](#)  
#5 by jnyborg was merged on May 16, 2022

### Changelog

- **Version 7:** Introduced HCAT3 (**not** downwards compatible): to merge spring and summer wheat, fix typos and extra z dimensions - issues [#11](#) [#13](#) [#20](#) [#21](#) [#22](#)
- **Version 6:** Updates to HCAT (downwards compatible) and fix FR and NL mappings - Pull request [#18](#)
- **Version 5:** Fix wrong year for NL - Pull request [#16](#)
- **Version 4:** Add preview of DE-NRW attribute table for zenodo (**no dataset changes**)
- **Version 3:** Fix wrong class mappings in NL and SK - Pull request [#10](#) issues [#7](#) and [#9](#)
- **Version 2:** Fix wrong class mappings in DK - Pull request [#5](#)
- **Version 1:** Initial publication

#### Versions

<a href="#">Version 7</a> 10.5281/zenodo.7851838	Apr 21, 2023
<a href="#">Version 6</a> 10.5281/zenodo.7476474	Jul 29, 2022
<a href="#">Version 5</a> 10.5281/zenodo.7433038	Jul 29, 2022
<a href="#">Version 4</a> 10.5281/zenodo.6937139	Jul 29, 2022
<a href="#">Version 3</a> 10.5281/zenodo.6868143	Jul 20, 2022

[View all 7 versions](#)

**Cite all versions?** You can cite all versions by using the DOI [10.5281/zenodo.6866846](#). This DOI represents all versions, and will always resolve to the latest one. [Read more.](#)



# Applications of EuroCrops

- Early Crop Classification
- Biodiversity Analysis
- Basis for automated crop label aggregation
- Central Platform for verifying contents of farmer's self declarations

## XAI FOR EARLY CROP CLASSIFICATION



*Ayshah Chan, Maja Schneider, and Marco Körner*

- 1 Analysing the Impact of European Agriculture on Biodiversity with an updated Hierarchical Crop and Agriculture Taxonomy (HCAV2)
- 2
- 3
- 4 Maja Schneider<sup>1,\*</sup>, David Gackstetter<sup>1,2</sup>, Jonathan Prexl<sup>3</sup>, Sebastian T. Meyer<sup>2</sup>, Marco Körner<sup>1</sup>

## Boosting Crop Classification by Hierarchically Fusing Satellite, Rotational, and Contextual Data

Valentin Barriere<sup>1,2,\*</sup>, Martin Claverie<sup>2,\*</sup>, Maja Schneider<sup>3</sup>,  
Guido Lemoine<sup>2</sup>, Raphaël d'Andrimont<sup>2</sup>

From regional to parcel scale: A high-resolution map of cover crops across Europe combining satellite data with statistical surveys

Arthur Nicolaus Fendrich<sup>a b c</sup>  , Francis Matthews<sup>a d</sup>,  
Elise Van Eynde<sup>a</sup>, Marco Carozzi<sup>c</sup>, Zheyuan Li<sup>e f</sup>, Raphael d'Andrimont<sup>a</sup>,  
Emanuele Lugato<sup>a</sup>, Philippe Martin<sup>c</sup>, Philippe Ciais<sup>b</sup>, Panos Panagos<sup>a</sup>

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# Future Outlook

- More Coverage in Europe expected in 2023
  - Czech Republic
  - More states in Germany
  - Romania
- More Training-Ready Datasets
- Update of TinyEuroCrops to HCAT3
- Tutorials on utilizing EuroCrops

# Time for Questions!

or

**WEB:**

[www.eurocrops.tum.de](http://www.eurocrops.tum.de)

<https://github.com/maja601/EuroCrops>

<https://zenodo.org/record/7851838>

**MAIL:**

[ayshah.chan@tum.de](mailto:ayshah.chan@tum.de)

**PUBLICATIONS:**

<https://arxiv.org/abs/2302.10202>

<https://arxiv.org/abs/2210.07178>

<https://ieeexplore.ieee.org/document/9883089>



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# References

- Fendrich, Arthur Nicolaus, et al. "From regional to parcel scale: A high-resolution map of cover crops across Europe combining satellite data with statistical surveys." *Science of the Total Environment* 873 (2023): 162300.
- Schneider, Maja, and Marco Körner. "Harnessing Administrative Data Inventories to Create a Reliable Transnational Reference Database for Crop Type Monitoring." *IGARSS 2022-2022 IEEE International Geoscience and Remote Sensing Symposium*. IEEE, 2022.
- Schneider, Maja, Christian Marchington, and Marco Körner. "Challenges and Opportunities of Large Transnational Datasets: A Case Study on European Administrative Crop Data." *arXiv preprint arXiv:2210.07178* (2022).
- Schneider, Maja, et al. "EuroCrops: All you need to know about the Largest Harmonised Open Crop Dataset Across the European Union." *arXiv preprint arXiv:2302.10202* (2023).
- Valentin, Barriere, et al. "Boosting Crop Classification by Hierarchically Fusing Satellite, Rotational, and Contextual Data." *arXiv preprint arXiv:2305.12011* (2023).