



European  
Commission

# European Big Data Hackathon 2025

Earth Observation: from Space to European Statistics

Brussels, 6–11 March 2025



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# MEA CULPA – Monitoring Ecosystem Accounts: Counting Usable Life Progress Analysis



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The **MEA CULPA** is a **Python-based** tool designed to automate the compilation of ecosystem extent accounts, following the methodological framework and reporting requirements outlined in the Eurostat guidance note (December 2024). It integrates remote sensing data (specifically **CORINE land cover**) and spatial boundary files (e.g., **NUTS0** and **NUTS2**) to produce standardized outputs in Copernicus Data Space Ecosystem.



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MEA CULPA respond to concepts used in SEEA EA (System of Environmental-Economic Accounting – Ecosystem Accounting) especially Ecosystem Extent Accounts statistics



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# Open source tools

Python, Rasterio, NumPy, Pandas, Geopandas,  
Dash, Jupyter\_dash, JupyterLab, pandas dash,  
dash\_leaflet dash\_extensions, geopandas  
dash,\_bootstrap\_components, plotly\_express, CDSE



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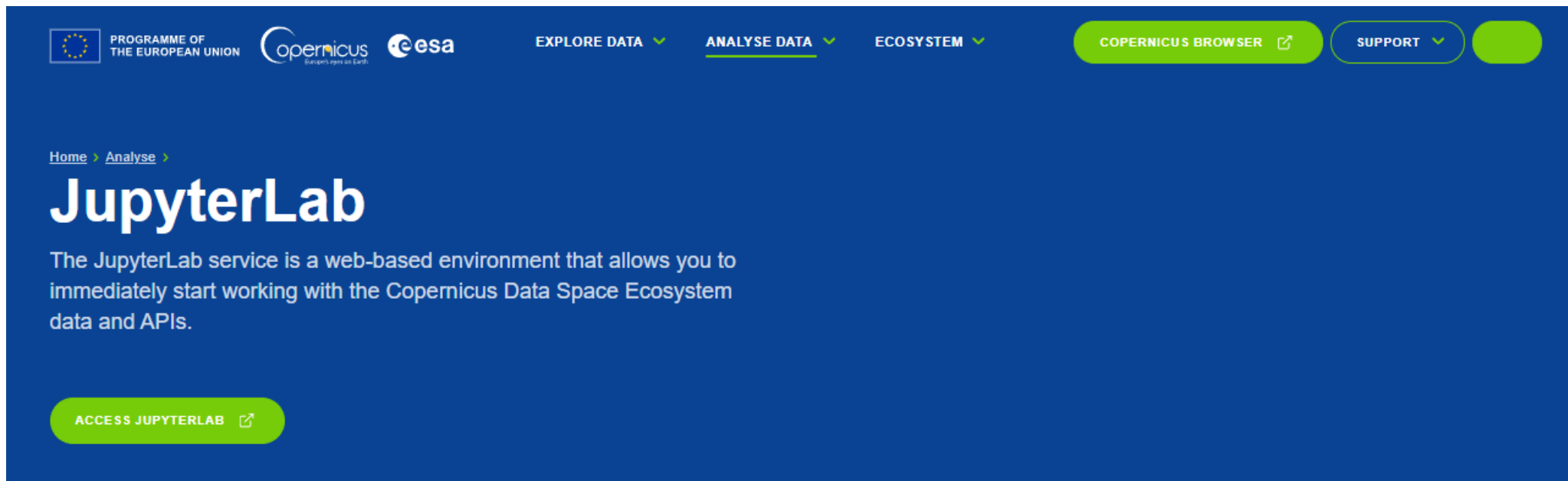
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# Processing platform

Whole processing is being done in Copernicus Data Space Ecosystem platform



The screenshot shows the top navigation bar of the Copernicus Data Space Ecosystem platform. It includes the European Union logo, the Copernicus logo, and the ESA logo. The navigation menu contains 'EXPLORE DATA', 'ANALYSE DATA', and 'ECOSYSTEM'. There are also buttons for 'COPERNICUS BROWSER' and 'SUPPORT'. The main content area features a breadcrumb trail 'Home > Analyse >', the title 'JupyterLab', and a description: 'The JupyterLab service is a web-based environment that allows you to immediately start working with the Copernicus Data Space Ecosystem data and APIs.' A green button labeled 'ACCESS JUPYTERLAB' is at the bottom.



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# Processing steps

Downloading raster and vector datasets



Corine Land Cover Data mapping and reclassification into Account Ecosystems classes for year 2012 and 2018



Zonal Statistics Calculation for (NUTS0) and regional (NUTS2) boundaries



Temporal Comparison and merging data from 2012 and 2018.



Calculating Differences: the change in area for each ecosystem category to highlight changes over time.



Export Final Outputs



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# Results



PROGRAMME OF  
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## Python script in that automates all processing steps in CDSE

```
File Edit View Run Kernel Tabs Settings Help
+ + + Filter files by name
/mystorage / 2025_Hackaton /
Name Last Modified
temp przedwczoraj
2012_2018_Ecosystem_accounts_EU-Copy1.ipynb 7 godzin temu
2012_2018_Ecosystem_accounts_EU.ipynb 4 godziny temu
2012_2018_Ecosystem_accounts.ipynb przedwczoraj
2012_level1_EA.tif wczoraj
2018_2012_Country_Diff.geojson wczoraj
2018_2012_NUTS2_Diff.geojson wczoraj
2018_level1_EA.tif wczoraj
CLC2012.tif wczoraj
CLC2018.tif wczoraj
Country_2012.geojson wczoraj
Country_2018.geojson wczoraj
ecosystem_areas_comparison.xlsx wczoraj
NUTS0_3M_EUROPE.geojson przedwczoraj
NUTS2_2012.geojson wczoraj
NUTS2_2018.geojson wczoraj
NUTS2_3M_EUROPE.geojson przedwczoraj

2012_2018_Ecosystem_accounts.ipynb
"""
Reclassifies a large raster to level1 using windowed (block) processing to avoid high memory usage.
"""
with rasterio.open(input_raster) as src:
    profile = src.profile.copy()
    nodata_value = src.nodata if src.nodata is not None else 0
    # Ensure nodata is within valid range (0-65535 for uint16)
    if nodata_value < 0 or nodata_value > 65535:
        nodata_value = 0

    # Update profile to use uint16, LZW compression, and proper nodata
    profile.update(dtype=rasterio.uint16, compress='lz', nodata=nodata_value)

with rasterio.open(output_raster, 'w', **profile) as dst:
    # Process the raster by its block windows to reduce memory usage
    for ji, window in src.block_windows(1):
        # Read the current window from the raster
        data = src.read(1, window=window).astype(np.int32)
        # Create an output array for this block filled with the nodata value
        level1_block = np.full(data.shape, fill_value=nodata_value, dtype=np.uint16)
        # For each CLC code, assign the corresponding Level1 value using the mapping dictionary
        for clc_value, l1 in clc_to_level1.items():
            mask = data == clc_value
            level1_block[mask] = l1
        # Write the processed block to the output raster
        dst.write(level1_block, 1, window=window)
return output_raster
```



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# Results

Python script in that automates all processing steps in CDSE:

- The script is designed with flexibility and scalability it allow users to calculate statistics at scales even below the regional (NUTS2) level, enabling analysis at finer geographic resolutions.
- The script is capable of generating ecosystem account statistics not only at the primary level but also at additional, more detailed classification levels (e.g., level 2 and level 3) in the future.



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# Results

## Indicators that cover EU ecosystem topology level 1

- 1 - Settlements and other artificial areas
- 2 - Cropland
- 3 - Grassland
- 4 - Forest and woodland
- 5 - Heathland and shrub
- 6 - Sparsely vegetated ecosystems
- 7 - Inland wetlands
- 8 - Rivers and canals
- 9 - Lakes and reservoirs
- 10 - Marine inlets and transitional waters
- 11 - Coastal beaches, dunes and wetlands



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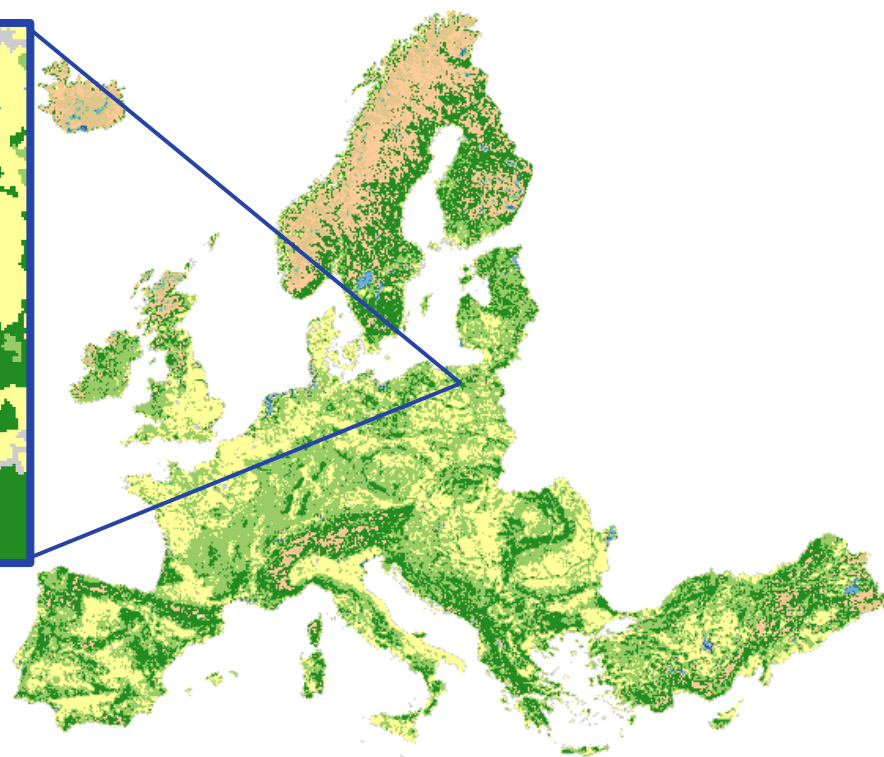
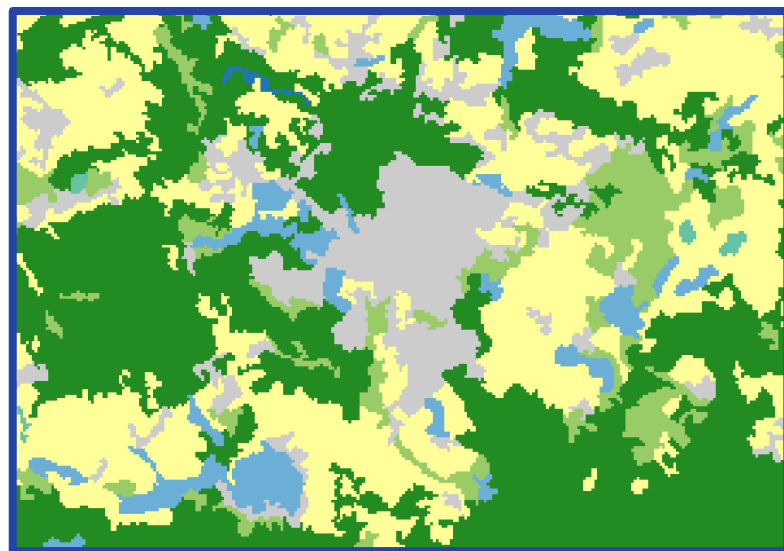
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# Ecosystem Extenet Accounts maps

Ecosystem Level 1 Classification for 2012 (downsampled by 20)



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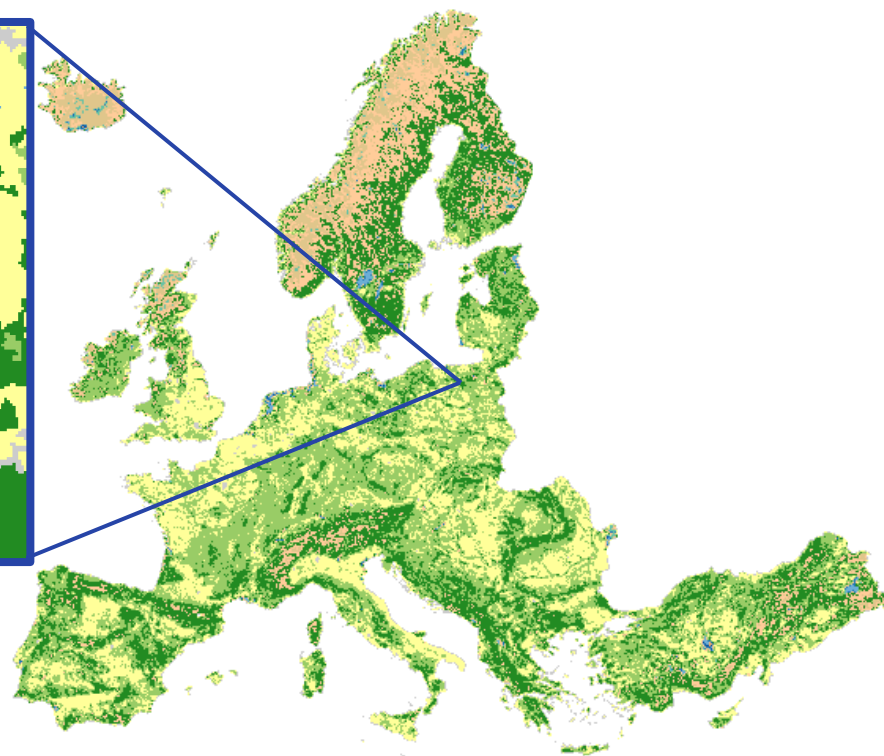
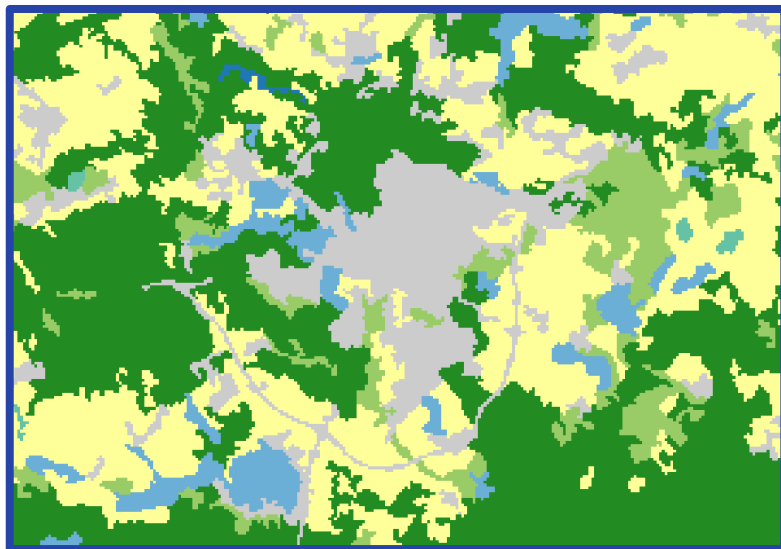
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# Ecosystem Extent Accounts maps

Ecosystem Level 1 Classification for 2018 (downsampled by 20)



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# Results

Excel Workbook: [ecosystem\\_areas\\_comparison.xlsx](#):

This workbook contains multiple sheets with detailed tabular data:

- Areas and shares of each ecosystem for Europe EEA countries (NUTS0) for the year 2012 and 2018
- Differences between 2012 and 2018 in ecosystem areas at the country level.
- Areas and shares of each ecosystem for Europe EEA countries at regional level (NUTS2) for 2012 and 2018.
- Differences between 2012 and 2018 in ecosystem areas at the regional level.



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# Results

## Country-Level GeoJSONs:

- Country\_2012.geojson: Merges 2012 country-level statistics with geographic boundaries.
- Country\_2018.geojson: Merges 2018 country-level statistics with geographic boundaries.
- 2018\_2012\_Country\_Diff.geojson: Shows the differences in country-level ecosystem areas between the two years.

## Regional-Level GeoJSONs:

- NUTS2\_2012.geojson: Merges 2012 regional statistics with geographic boundaries.
- NUTS2\_2018.geojson: Merges 2018 regional statistics with geographic boundaries.
- 2018\_2012\_NUTS2\_Diff.geojson: Displays the changes in ecosystem areas at the regional level.



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# Dashboard - demo



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# MEA CULPA - Monitoring Ecosystem Accounts: Counting Usable Life Progress Analysis

Select year:

2012

Ecosystems data are available only in 2012 and 2018

Select map type:

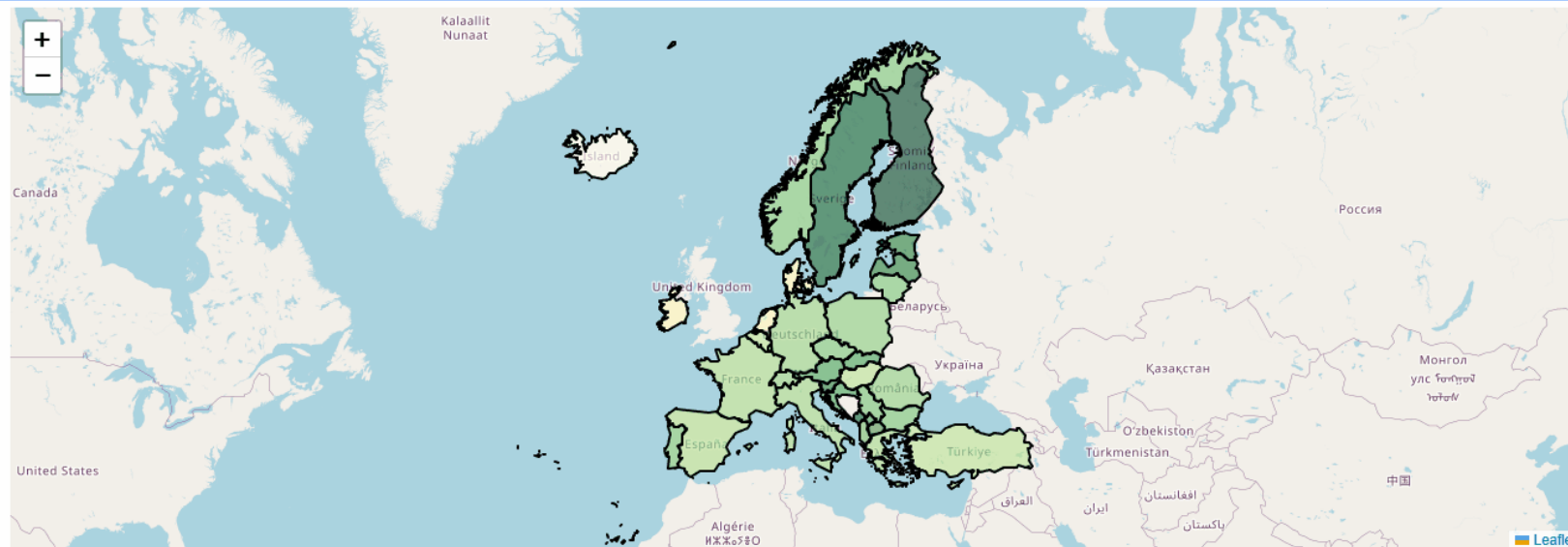
Country

Select ecosystem indicator:

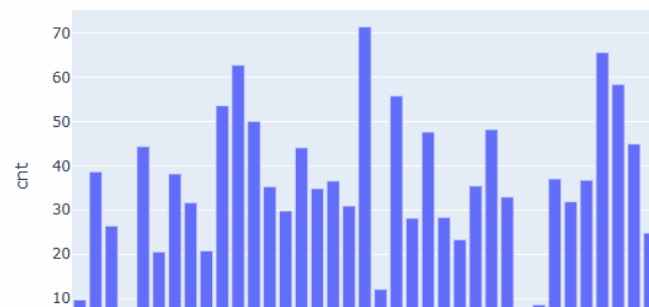
4 - Forest and woodland S...

Select Eurostat indicator:

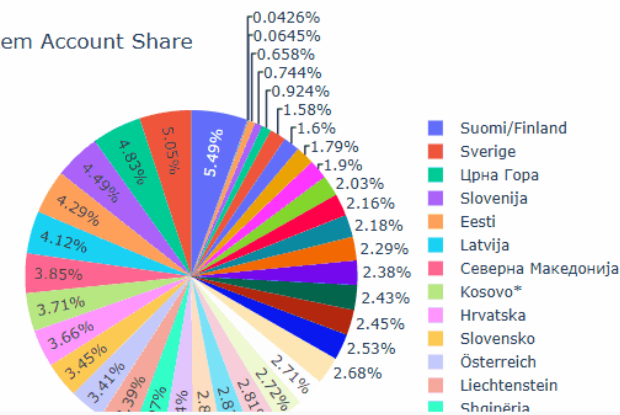
None



Count by NUTS



Ecosystem Account Share



MEA CULPA Dashbord v0.4.8 (Veni, Vidi, Computavi) - Poland Team1



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# Team NSI\_PL\_T1



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