POLITECNICO MILANO 1863 | DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Land Use and Coverage Area frame Survey (LUCAS)

21.10.2025 | Polychronis Kolokousis

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What is LUCAS

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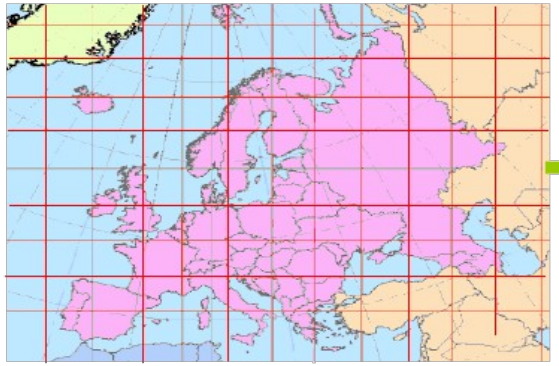
The LUCAS Grid

Eurostat implements the Land Use and Coverage Area frame Survey (LUCAS), which is an area-frame statistical survey on land use and cover in place since 2000; the LUCAS sampling is based on two-phase sampling with stratification of all master sample points:

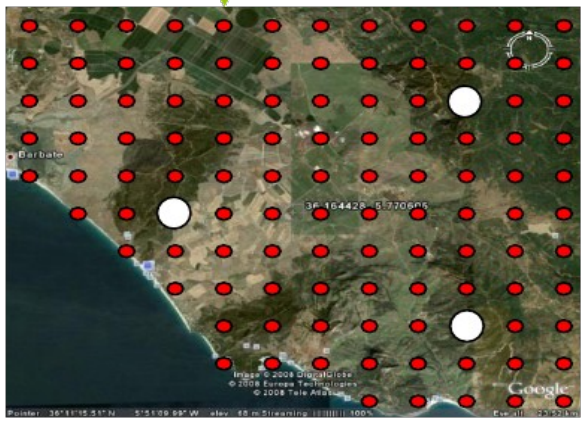
- Base grid: The **LUCAS base** is obtained by using a **1 km²** grid (resulting from the INSPIRE recommendations) with a systematic spatial sampling design (**~4 million points**).
- Master grid: The **LUCAS master** is a subset (**~1 million points**) of the base using a **2 x 2 km²** grid. Each of these points is classified into k land cover categories (the strata) based on dual photointerpretation of **aerial photos** (0.3-0.6 m resolution) or **VHR satellite images** (2 m resolution. In the present update 10 strata and two parameters are foreseen.
- One portion of the LUCAS master points (e.g. 200K) are visited on site and detailed datasheets are delivered by the surveyors.

The LUCAS Master Grid Photointerpretation Process



1 100 000 points

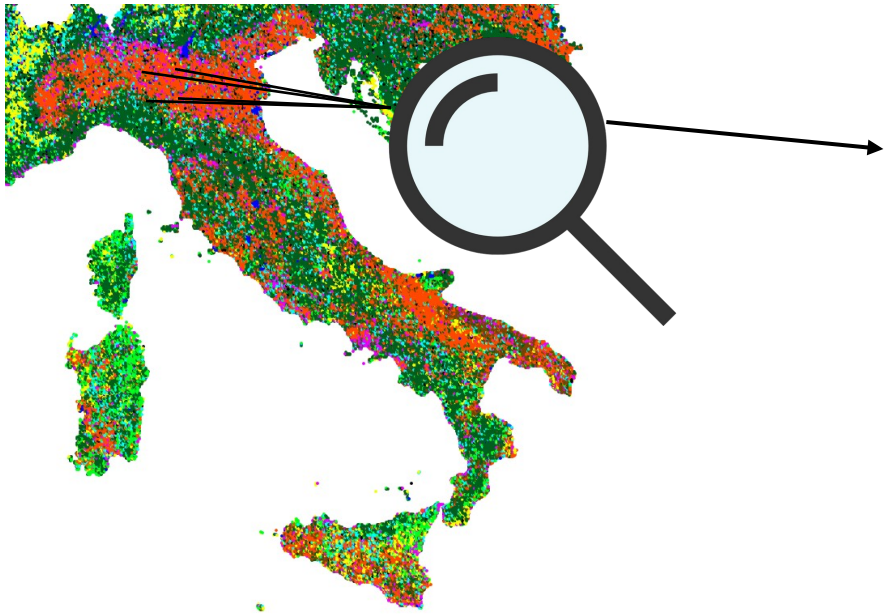
Photointerpretation:
Classification in 10 strata

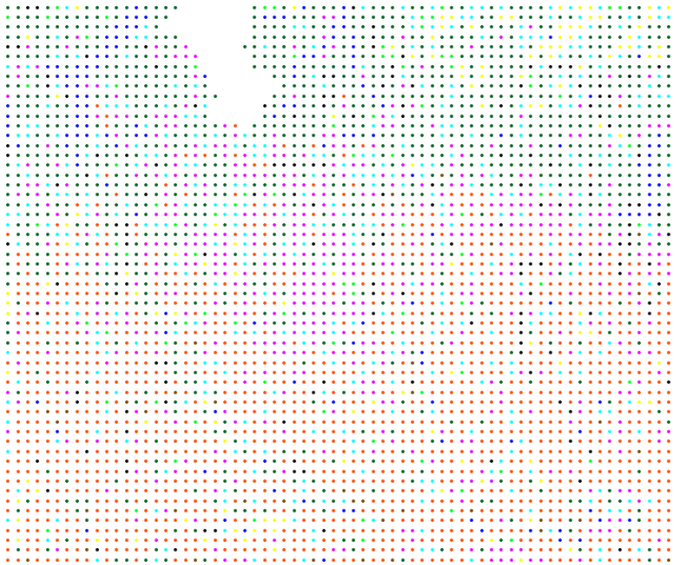


Stratum	Description	Correspondence to LUCAS Land Cover classification
1	Arable land	(B1X..B5X) Cereals, root crops, non-permanent industrial crops, dried pulses, vegetables and flowers, fodder crops
2	Permanent crops	(B7X..B8X) Fruit trees and fruit bushes, other permanent crops (vineyards, olive trees)
3	Grass	(EXX) Grassland, with or without sparse tree/shrub cover
4	Wooded areas	(CXX) Areas where at least 10% is covered by tree canopy
5	Shrubs	(DXX) Shrub land with or without sparse tree cover
6	Bare surface, low or rare vegetation	(FXX) Bare land: areas with no vegetation (rocks, sand, and lichens) or areas covered less than 10% by dominant species of vegetation.
7	Artificial, constructions and sealed areas	(AXX) Built-up and artificial non-built-up areas
8	Inland water	(GXX, except G30) Surfaces covered by water or ice, either permanently or for most of the year
9	Transitional waters and coastal waters	Points that are not part of "land" nor "inland water" areas (includes G30)
10	Impossible to PI	Points that cannot be photo interpreted (e.g. image not available, clouds...). Points in this class are considered an exception subject to acceptance from Eurostat.

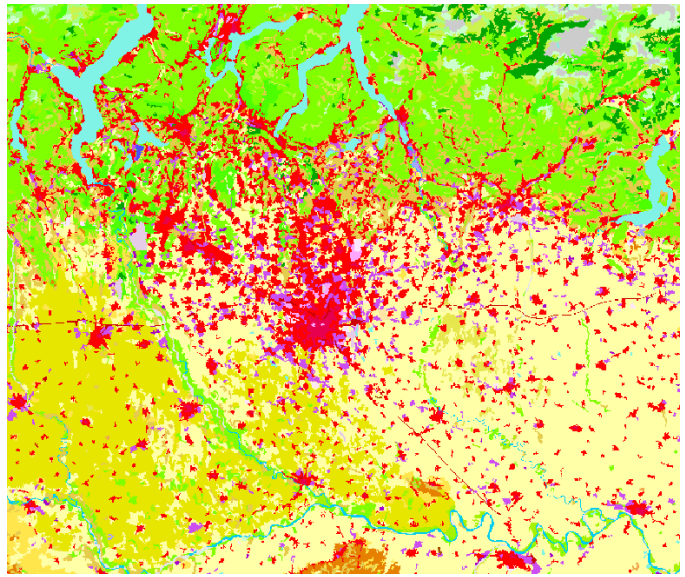
LUCAS vs LULC

When the LUCAS points are presented in colour according to their strata they look as a LULC map when zoomed out, but when zoomed in it is obvious that LUCAS is a point database, which is used for statistics **not** for LULC mapping.





LUCAS 2018

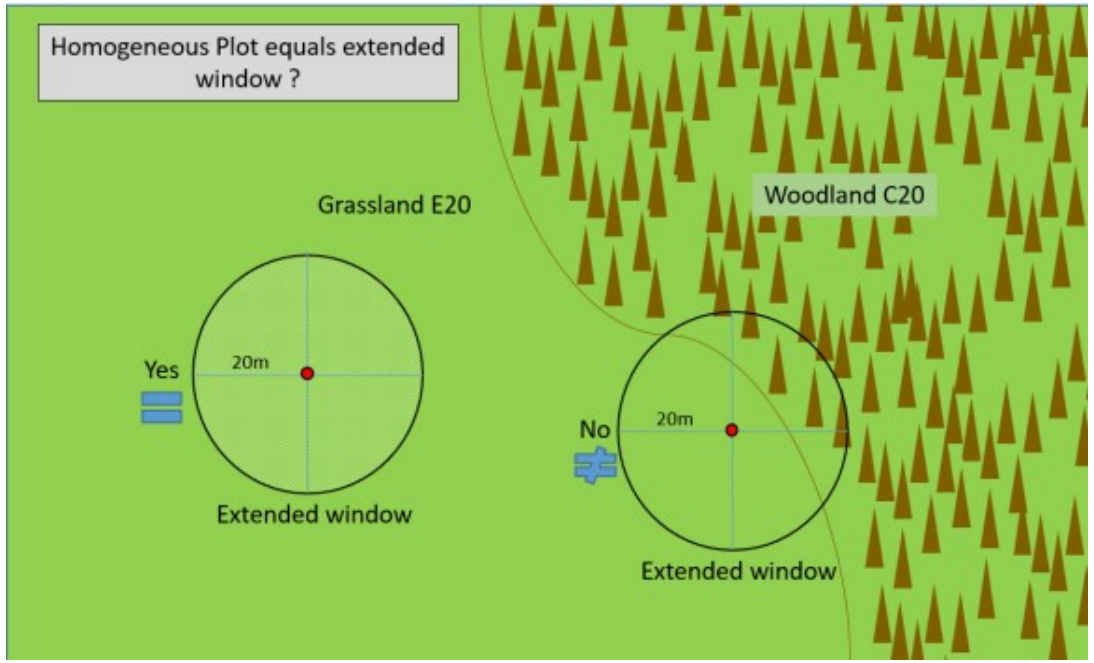


CLC 2018

LUCAS scale & observation windows

In LUCAS there are two observation windows:

1) the homogeneous plot (3m diameter)
2) the extended window of observation (20 mater diameter)

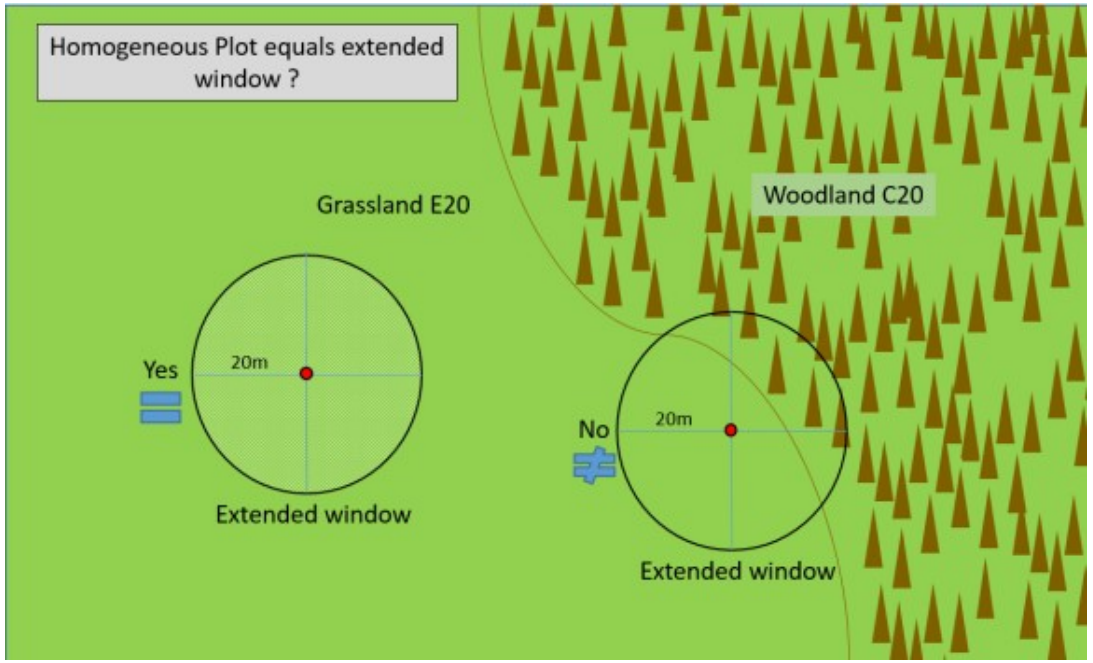


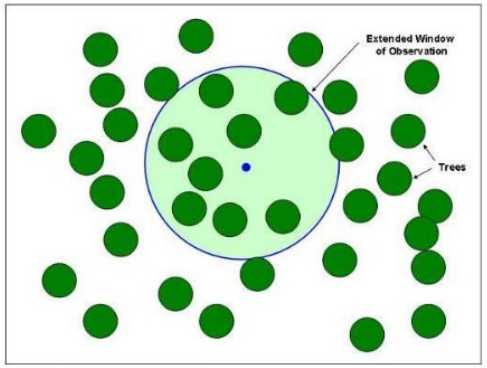
LUCAS rules

There are many rules to follow during LUCAS survey & photointerpretation, which are not presented here in detail, like:

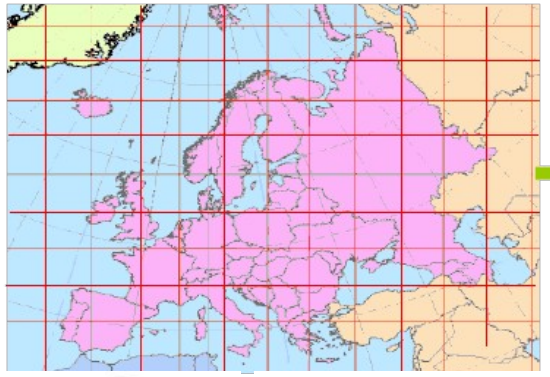
- Look to the North/East
- When to use the EWO
- Disregard narrow (<3m) linear features
- 10% density rule for wooded & shrubs
- Dual strata rules

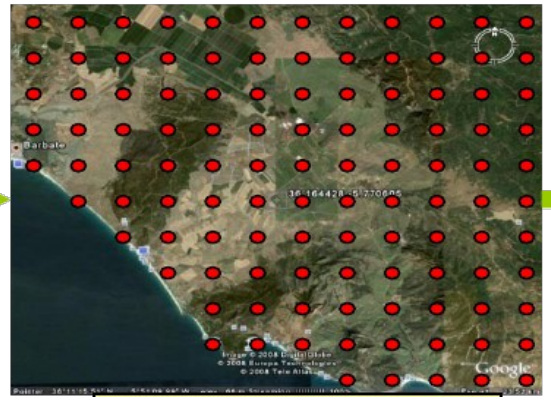
etc





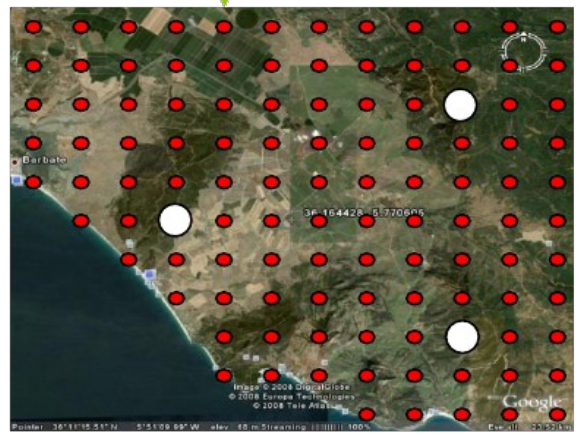
The LUCAS database





Photointerpretation:
Classification in 10 strata

Field	Description	Observation
IDPOINT	Point numeric unique identifier	Provided by Eurostat
X_LAEA	Lambert Azimuthal Equal Area X coordinate	Provided by Eurostat
Y_LAEA	Lambert Azimuthal Equal Area Y coordinate	Provided by Eurostat
EWO	Extended window of observation used	Y/N
LTNE	Look to North/East	N/E/8
STRATA1_S1	Main code of the stratum	1..10
STRATA2_S1	Alternative code of stratum	1..10 | Null (possible combinations)
WET_S1	Parameter for wetland	Yes | No | Not possible to detect
ASSOC_S1	Parameter for areas associated to residential, industrial or services	Yes | No | Not possible to detect
INTRPRT	ID of the photo interpreter	
STRATA1_S2	Main code of the stratum	1..10
STRATA2_S2	Alternative code of stratum	1..10 | Null (possible combinations)
WET_S2	Parameter for wetland	Yes | No | Not possible to detect
ASSOC_S2	Parameter for areas associated to residential, industrial or services	Yes | No | Not possible to detect
INTRPRT	ID of the photo interpreter	
DATE_PI	YYYYMMDD HHMMSS of last photointerpretation	
QC	Point to be controlled	1/0
STRATA1_S3	Main code of the stratum – Quality Controller intervention	1..10
STRATA2_S3	Alternative code of stratum – Quality Controller intervention	1..10 | Null (possible combinations)
WET_S3	Parameter for wetland – Quality Controller intervention	Yes | No | Not possible to detect
ASSOC_S3	Parameter for areas associated to residential, industrial or services-	Yes | No | Not possible to detect
INTRPRT	ID of photo interpreter	
CMNT	Comments from the photo interpreter	Structured/Free



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ML for LUCAS

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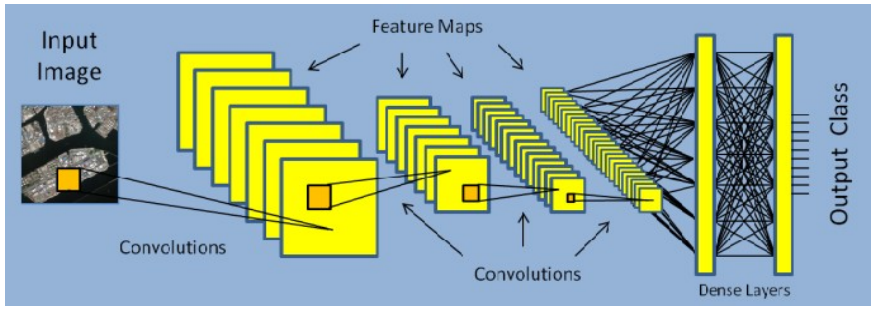
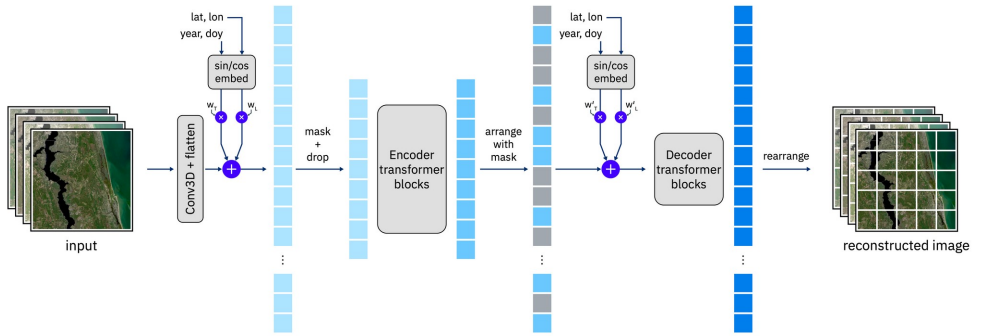
LUCAS and ML

Eurostat wishes to develop an automatic classification algorithm, which, based on the already 1M photointerpreted and classified image chips of the LUCAS master grid as well as other input data, will classify the 3M points of the base grid. Input data sources will include:

a) LUCAS survey data from the year 2025, 2022, 2016 (in-situ data),
b) LUCAS master photointerpretation data from 2025 and 2016
c) Sentinel 1 / Sentinel 2 timeseries
d) DEM data
e) Copernicus VLCC data

Due to the nature of the LUCAS training data (i.e. point based) and the image datasets to be classified (mostly very high resolution RGB imagery from various sources) the most appropriate ML model architecture to be utilized seems to be a model based on Convolutional Neural Networks (CNN), but other models have to be tested. The application of the LUCAS rules is not an easy task.





LUCAS 2016 (rev. 2018) LULC data download

Official data download

https://ec.europa.eu/eurostat/web/lucas/database/2018

QGIS project

https://drive.google.com/file/d/10jOOHaA7xYBqqb48al9j5EnHjuuY8WBM/view?usp=sharing

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Grazie per l’attenzione

Contatti

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