

StatEO

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Very High-Resolution Land Cover Mapping: A Reusable Pipeline for Official Statistics

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WP7 Project Goal

Assess whether **AI/ML** models be **generalised** over space (countries) and time (periods) and under what conditions?

French Land cover from Aerospace ImageRy (FLAIR)

Deep learning model by **IGN** France for pixel-level **land cover** classification from **aerial orthophotos**

Architecture: Swin-Transformer encoder + UPerNet decoder | **15 land cover classes**

Trained on ~2,800 km² of annotated French imagery

Pilot NUTS2 Regions

DK Denmark — **Region Hovedstaden**

AT Austria — **Salzburg**

IT Italy — **Veneto**

How the Model Works — Pixel-Level Classification

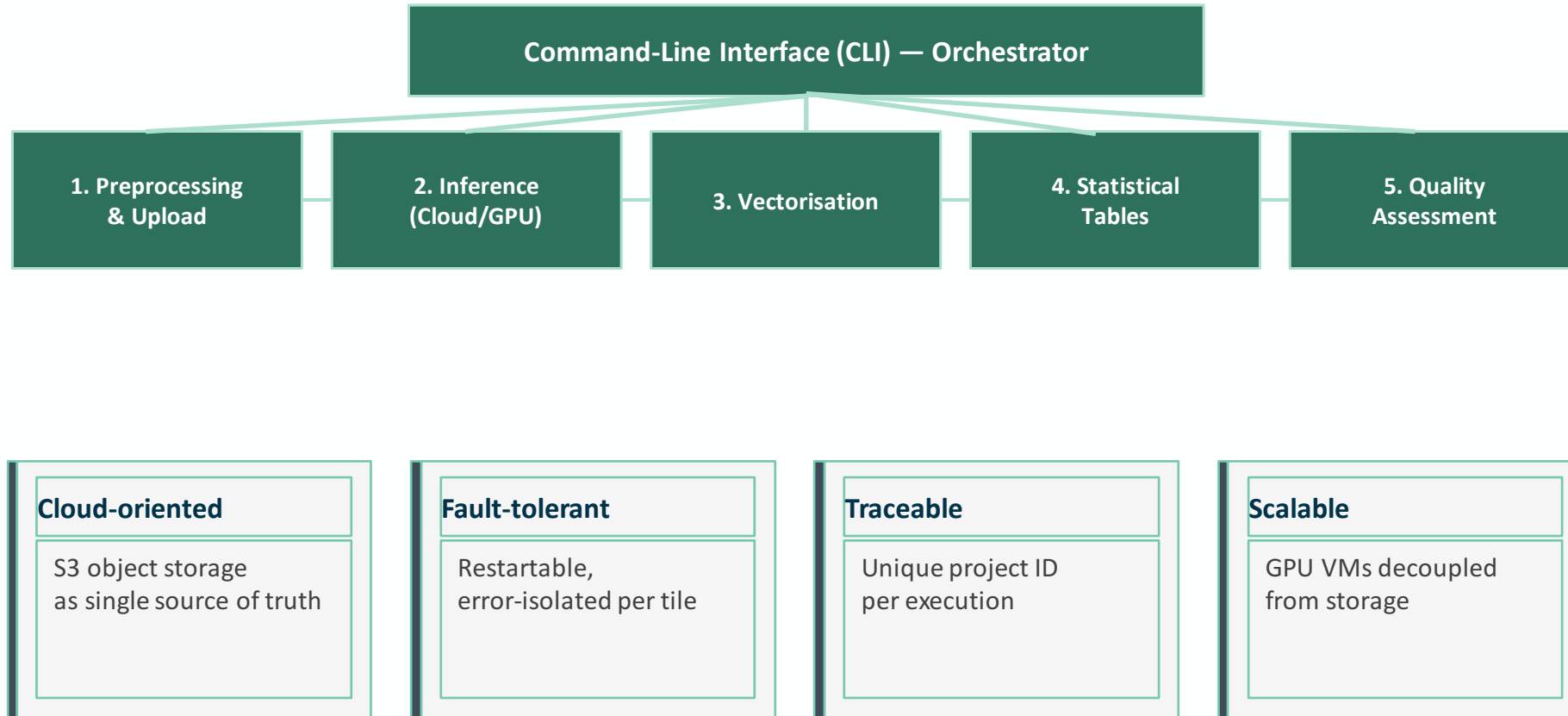


- building
- greenhouse
- swimming_pool
- impervious surface
- pervious surface
- bare soil
- water
- snow
- herbaceous vegetation
- agricultural land
- plowed land
- vineyard
- deciduous
- coniferous
- brushwood

Datasets: Three NUTS2 Pilot Regions

	DK Denmark (Region Hovedstaden)	AT Austria (Salzburg)	IT Italy (Veneto)
Bands	R, G, B, NIR	RGB + NIR	RGB + NIR
Bit depth	32-bit	8-bit	8-bit
Area	2,559 km ²	7,154 km ²	18,399 km ²
Resolution	10–12.5 cm	20 cm	20 cm
Format	ECW	WMS / GeoTiff	ECW
Tiling	Yes	Yes(3 tiles)	Yes (2,253 tiles)
Latest year	2024	2024	2021

Key challenge: different formats, bit depths, resolutions and tiling — all requiring a harmonisation step before inference



Processing runs on CREODIAS, the cloud infrastructure offered by the Copernicus Data Space Ecosystem (CDSE)

Accuracy Results — Denmark (Region Hovedstaden)



Validation against three independent sources

Validation source	# Points	BS (0–1)	BSS	Jaccard	Accuracy
Manual photointerpretation	993	0.05	0.88	0.72	0.996
LUCAS 2018 strata	643	0.39	-0.46	0.26	0.739
LUCAS 2022 survey	361	0.38	-0.10	0.30	0.648

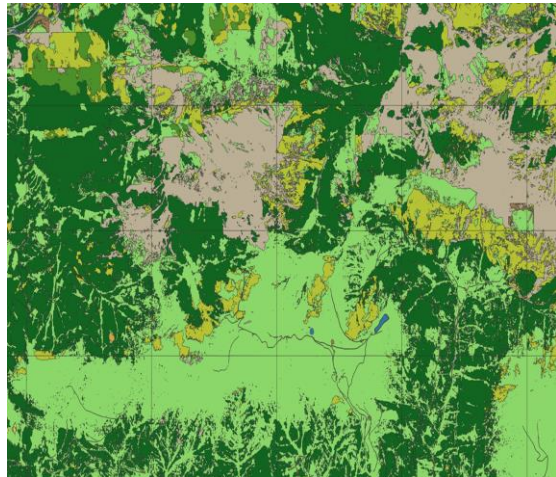
Why lower performance with LUCAS?

- o Definitional mismatch: FLAIR ↔ LUCAS classes require many-to-many mapping
- o Field observations (LUCAS) vs. aerial view (orthophoto) — inherently different perspectives
- o Temporal gap: Danish orthophotos 2024 vs LUCAS surveys 2018 / 2022

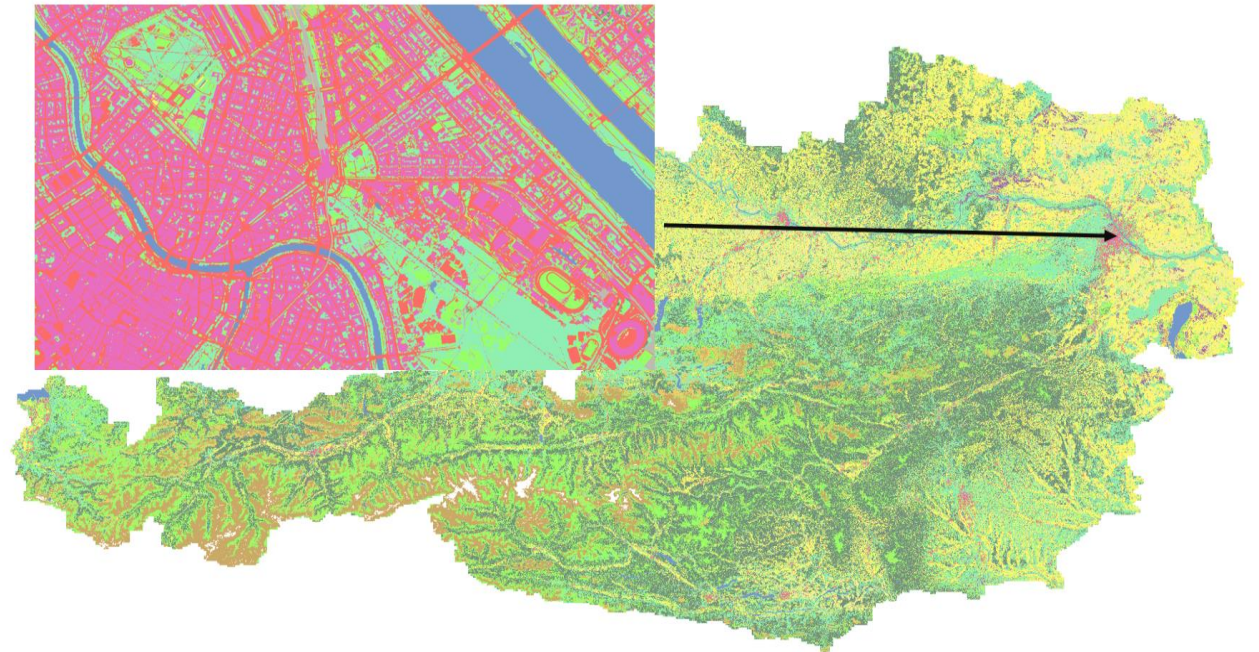
Land Cover Results — Salzburg (Austria)

Salzburg 2024 FLAIR land cover classes

FLAIR Class	%	FLAIR Class	%
herbaceous vegetation	30.29%	water	0.93%
coniferous	26.92%	building	0.83%
deciduous	11.97%	pervious_surface	0.76%
bare soil	11.70%	plowed land	0.10%
agricultural land	9.15%	swimming_pool	0.00%
brushwood	4.59%	vineyard	0.00%
impervious_surface	1.44%	greenhouse	0.00%
snow	1.30%		



Vectorial Rural detail — level of spatial pattern captured by the model



Full country run — raster + vector output (RGB model)

Veneto 2021 FLAIR land cover classes

FLAIR Class	%	FLAIR Class	%
Agricultural land	31.19	Brushwood	2.81
Herbaceous veg.	17.53	Bare soil	2.7
Deciduous	15.98	Pervious surface	1.88
Coniferous	7.77	Vineyard	1.59
Water	7.04	Greenhouse	0.11
Plowed land	4.34	Snow	0.04
Impervious surface	4.01	Swimming pool	0.01
Building	3		

Veneto 2021 FLAIR mapped vs LUCAS 2022

LUCAS Class	FLAIR classes mapped	FLAIR %	LUCAS %
B Cropland	Agricultural, Plowed, Vineyard	37.12	38.2
C Woodland	Deciduous, Coniferous	23.75	27
E Grassland	Herbaceous veg.	17.53	15.5
A Artificial	Building, Greenhouse, Impervious, Pervious	9	10.5
G Water	Water, Snow, Swimming pool	7.09	3.3
F Bare soil	Bare soil	2.7	2.9
D Shrubland	Brushwood	2.81	2.4
H Wetland	—	0	0.2

1 Pipeline

A modular, cloud-oriented, fault-tolerant open-source pipeline, running on CREODIAS/CDSE, successfully tested at regional scale across three EU countries.

2 Results

Strong accuracy against photointerpretation in Denmark. Differences with LUCAS are expected and explainable. Aggregated statistics for Veneto are in good agreement with LUCAS 2022.

3 Next Steps

Complete full pipeline run for Denmark and Austria. Harmonised statistics and quality assessment at NUTS2 level for all countries. Evaluate fine-tuning FLAIR on non-French imagery.

Code available under EUPL v1.2: https://github.com/AIML4OS/WP7_landcover

AIML4OS WP7 — Land Cover Team

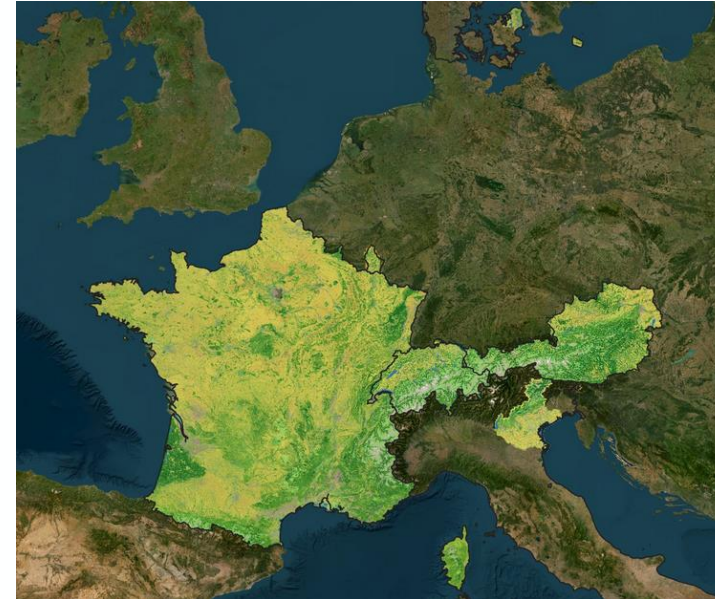
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Pipeline code (EUPL v1.2):

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