



DEVELOPEMENT OF A LAND COVER MAP FOR HECTOMETRIC NWP USING MACHINE LEARNING

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Met Éireann

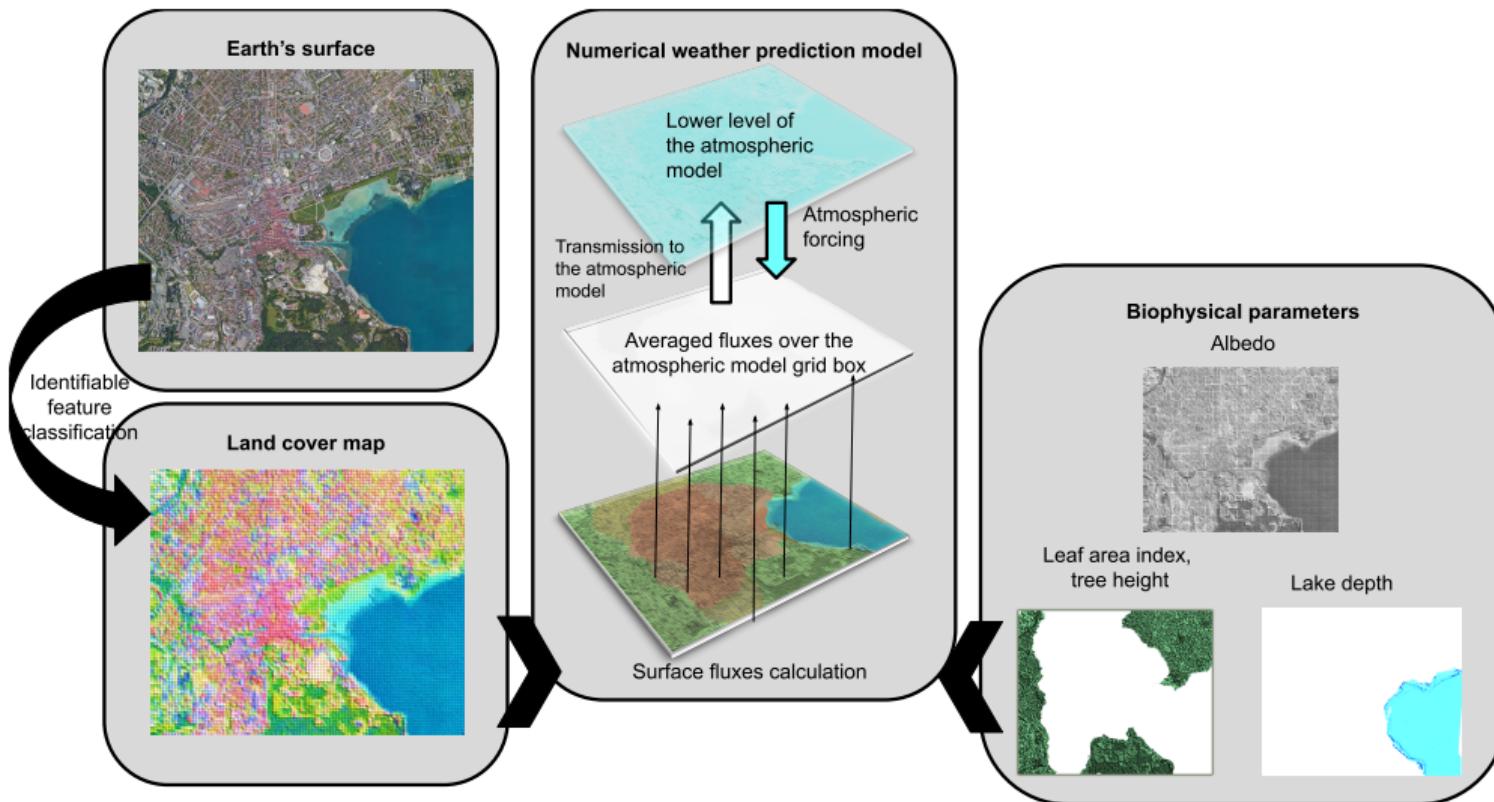
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INTRODUCTION

LAND COVER MAP AND ITS USE IN NWP

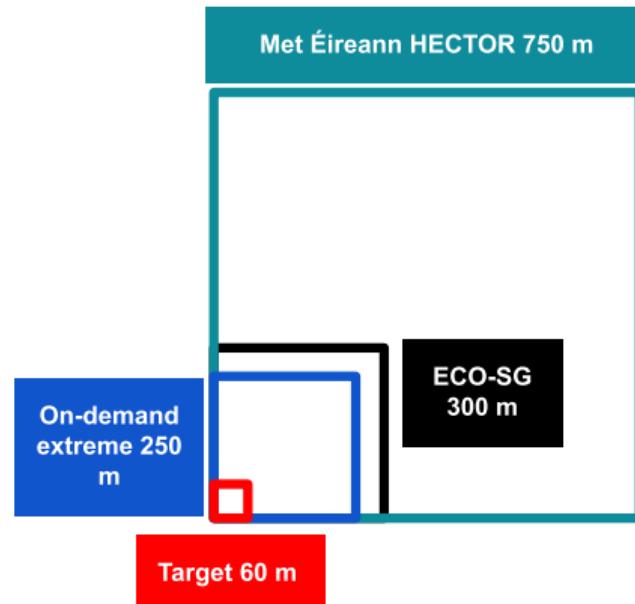


WHY PRODUCE A NEW LAND COVER MAP FOR HECTOMETRIC NWP?

- Hectometric NWP requires fine resolution land cover map
- No fine-resolution dataset (below 100 m) can be used directly in NWP
- ML algorithms are widely used in the land-cover land-use community

Objective

- Leverage open-access data and AI to produce a high-resolution (60m) physiography map with ECOCLIMAP-SG (ECO-SG) labels.



MATERIAL

MATERIAL TO BUILD A REFERENCE MAP

Heterogeneous 35 maps used as Backbone and/or specialist map:

- Backbone maps**
- High-resolution
 - Easy translation to primary label
 - Global or local coverage



Occupation des sols France



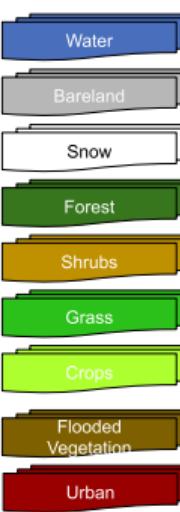
Primary labels

Used to distinguish ECOCLIMAP-SG label from primary label

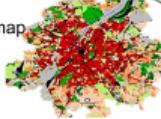


Specialist maps

Used to distinguish ECOCLIMAP-SG label from primary label



Geoclimate LCZ map
Brussels



ECOCLIMAP-SG labels

Sea and oceans
Lakes
Rivers
Bare land
Rocks
Permanent snow and ice
Boreal broadleaf deciduous
Temperate broadleaf deciduous
Tropical broadleaf deciduous
Temperate broadleaf evergreen
Tropical broadleaf evergreen
Boreal needleleaf evergreen
Temperate needleleaf evergreen
Boreal needleleaf deciduous
Shrubs
Boreal grassland
Temperate grassland
Tropical grassland
Winter C3 crops
Summer C3 crops
C4 crops
Flooded trees
Flooded grassland
LCZ1: compact high-rise
LCZ2: compact midrise
LCZ3: compact low-rise
LCZ4: open high-rise
LCZ5: open midrise
LCZ6: open low-rise
LCZ7: lightweight low-rise
LCZ8: large low-rise
LCZ9: sparsely built
LCZ10: heavy industry

MATERIAL FOR AI/ML METHODS



Segmentation approach

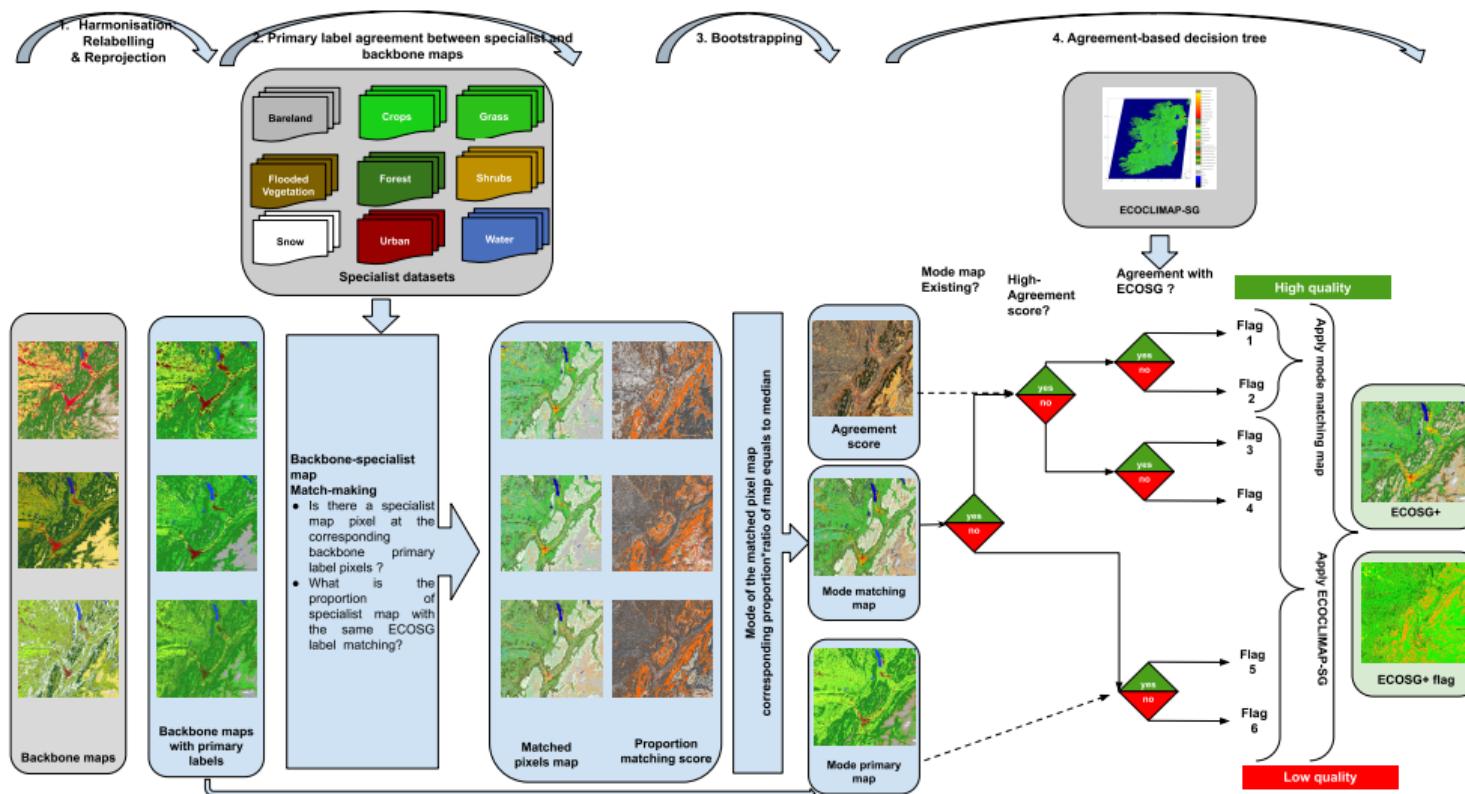
- Imagery from BigEarthNet dataset
- Land cover from ECOSG+

Map translation approach

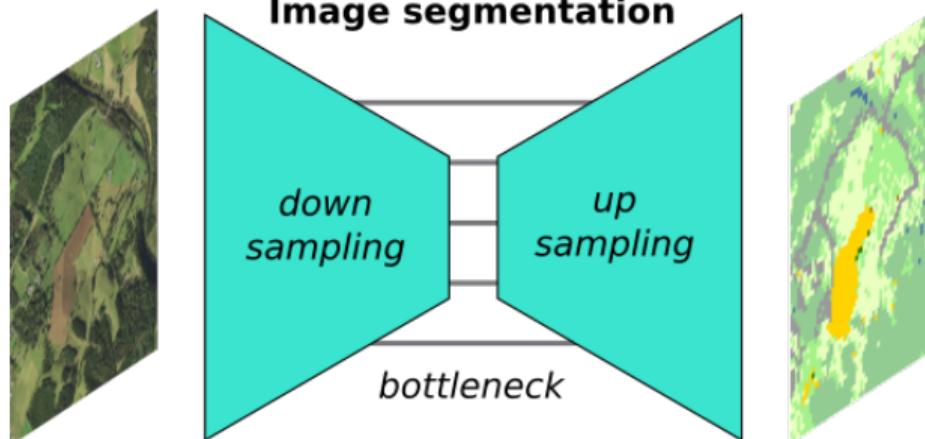
- Training
 - Land covers: ESA World Cover, OCS2018, CLC2018, ECOSG, ECOSG+
 - Domain: France's mainland
- Validation
 - From ESA World Cover to ECOSG+
 - Domain: part of EURAT east of France

METHODS

AGREEMENT-BASED REFERENCE MAP BUILDING



THE SEGMENTATION APPROACH



Retained configuration: DeepLabV3 segmentation algorithm with ResNet50 backbone pretrained on CORINE first-level classes. Segmentation from Sentinel-2 RGB bands to ECOSG+

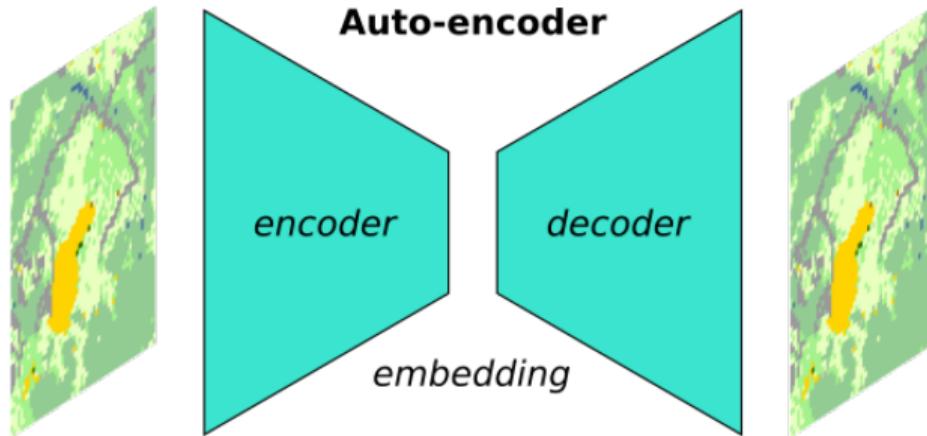
Pros

- High resolution (up to 10 m)
- Global coverage

Cons

- Cloud removal (optical bands)
- Static images (no information on seasonal variations)
- Cumbersome data processing

THE MAP TRANSLATION APPROACH



Retained configuration: CNN auto-encoder (4 double conv layers) with 50 channels in the latent space. Translation from ESA World Cover to ECOSG+

Pros

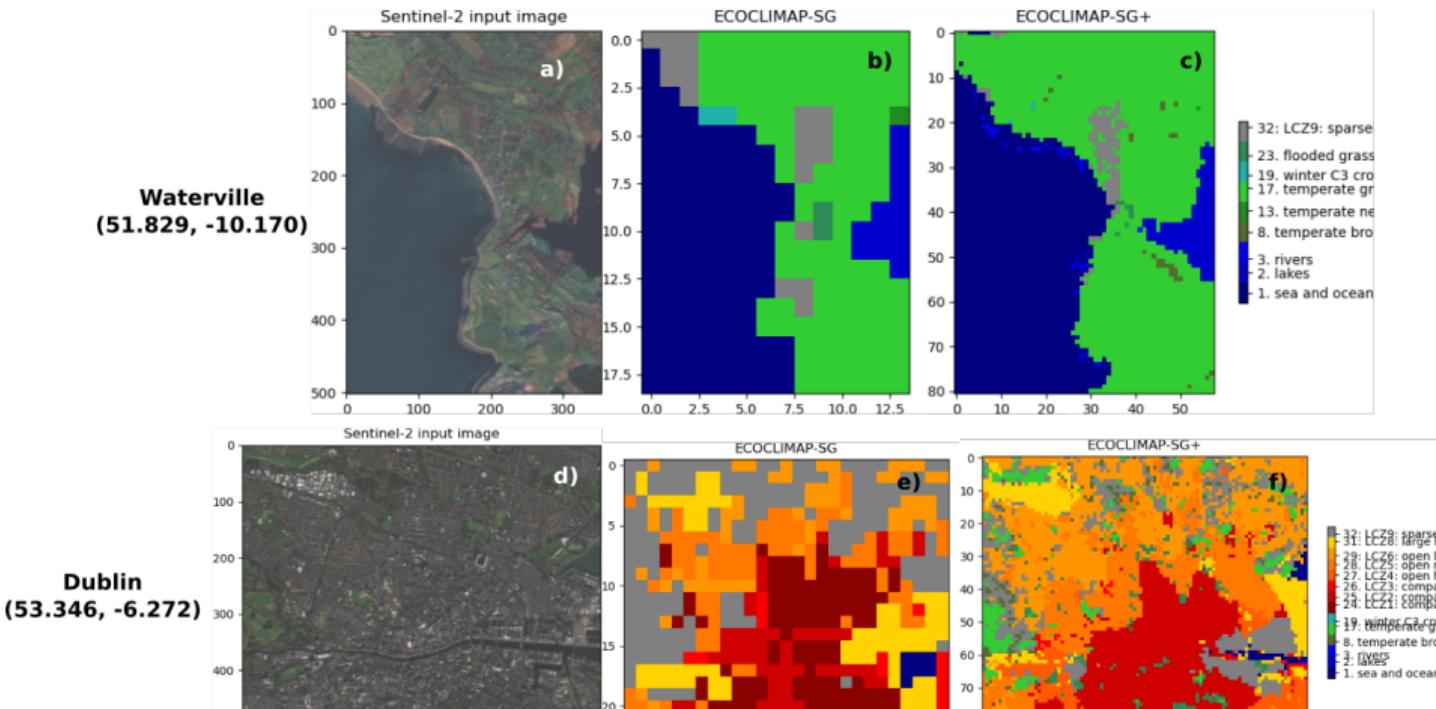
- High resolution (up to 10 m)
- Global coverage
- No remote sensing data used

Cons

- Limitations in the detection of some labels

RESULTS

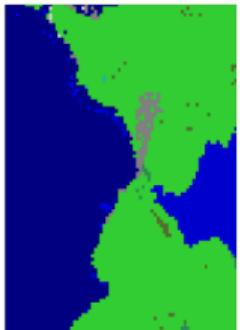
REFERENCE MAP QUALITATIVE EVALUATION



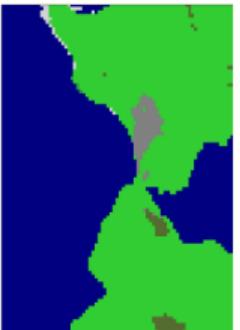
AI METHODS QUALITATIVE EVALUATION

Waterville

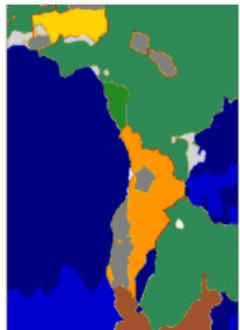
ECOCLIMAP-SG+
(reference)



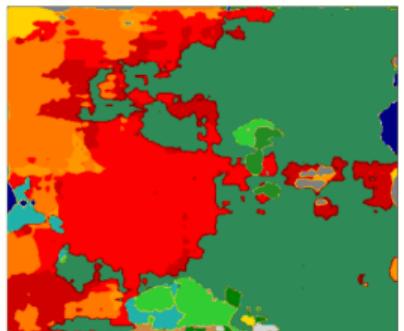
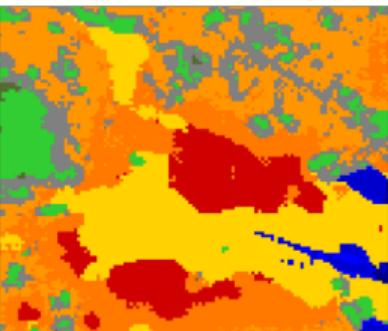
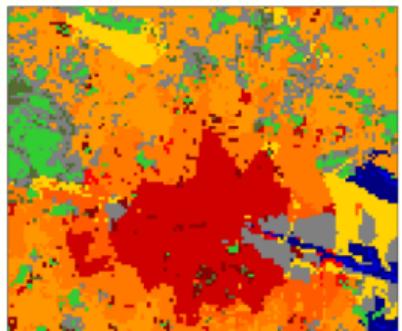
Map translation
(prediction)



Segmentation
(prediction)

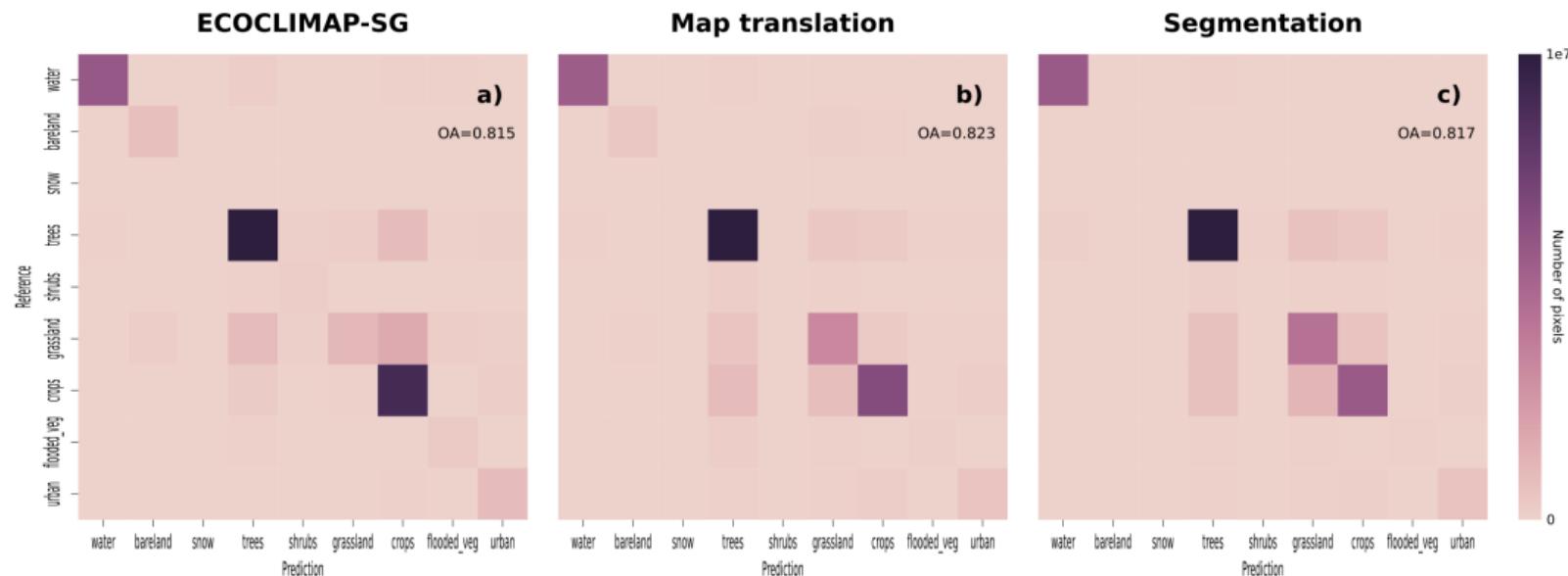


Dublin



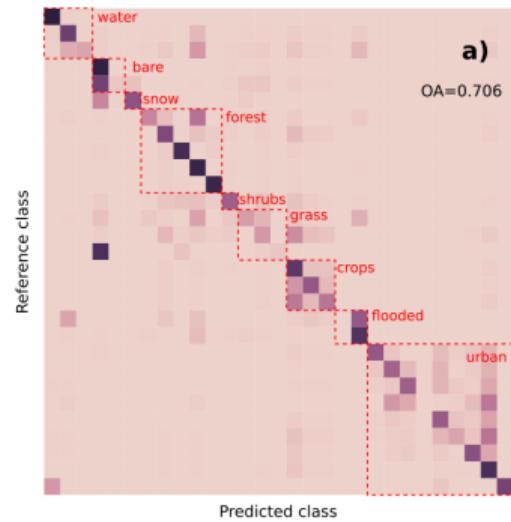
- 33: LCZ10: heavy industry
- 32: LCZ9: sparsely built
- 31: LCZ8: large low-rise
- 30: LCZ7: lightweight low-rise
- 29: LCZ6: open low-rise
- 28: LCZ5: open midrise
- 27: LCZ4: open high-rise
- 26: LCZ3: compact low-rise
- 25: LCZ2: compact midrise
- 24: LCZ1: compact high-rise
- 23: flooded grassland
- 22: flooded trees
- 21: C4 crops
- 20: summer C3 crops
- 19: winter C3 crops
- 18: tropical grassland
- 17: temperate grassland
- 16: boreal grassland
- 15: shrubs
- 14: boreal needleleaf deciduous
- 13: temperate needleleaf evergreen
- 12: boreal needleleaf evergreen
- 11: tropical broadleaf evergreen
- 10: temperate broadleaf evergreen
- 9: tropical broadleaf deciduous
- 8: temperate broadleaf deciduous
- 7: boreal broadleaf deciduous
- 6: permanent snow
- 5: bare rock
- 4: bare land
- 3: rivers
- 2: lakes
- 1: sea and oceans
- 0: no data

AI METHODS QUANTITATIVE EVALUATION (1/2) - PRIMARY LABELS

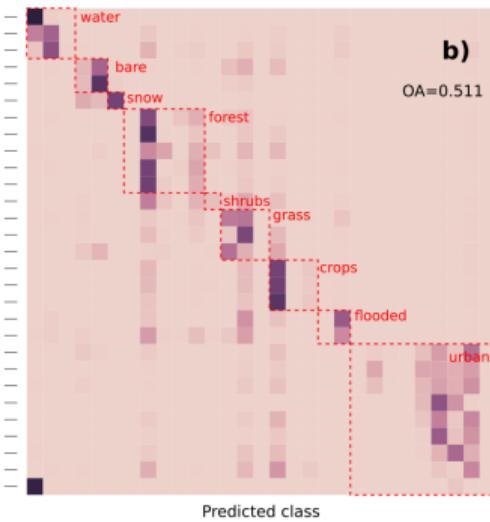


AI METHODS QUANTITATIVE EVALUATION (2/2) - ECOSG LABELS

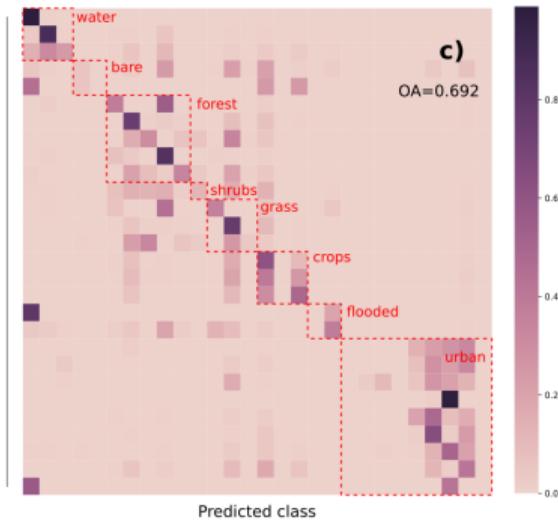
ECOCLIMAP-SG



Map translation



Segmentation



CONCLUSION

CONCLUSION

- We built a reference map (ECOSG+) at 60 m resolution with ECOSG labels by mixing 35 different land cover maps.
- Quality score are provided for each pixel, depending on how well the relevant maps agree.
- Different AI methods have been tested to extent the reference where the quality is low.
- The map translation approach is the most promising. It translates ESA World Cover to ECOSG+
- The qualitative evaluation of ECOSG+ is satisfying. Quantitative evaluation still to be done.
- The map translation proves better than ECOSG on primary labels but still fails to detect all ECOSG labels.