BioSpace25 - Biodiversity insight from Space
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Mapping ecosystem extent under the SEEA EA framework: complementarity of biodiversity and earth observation data needs

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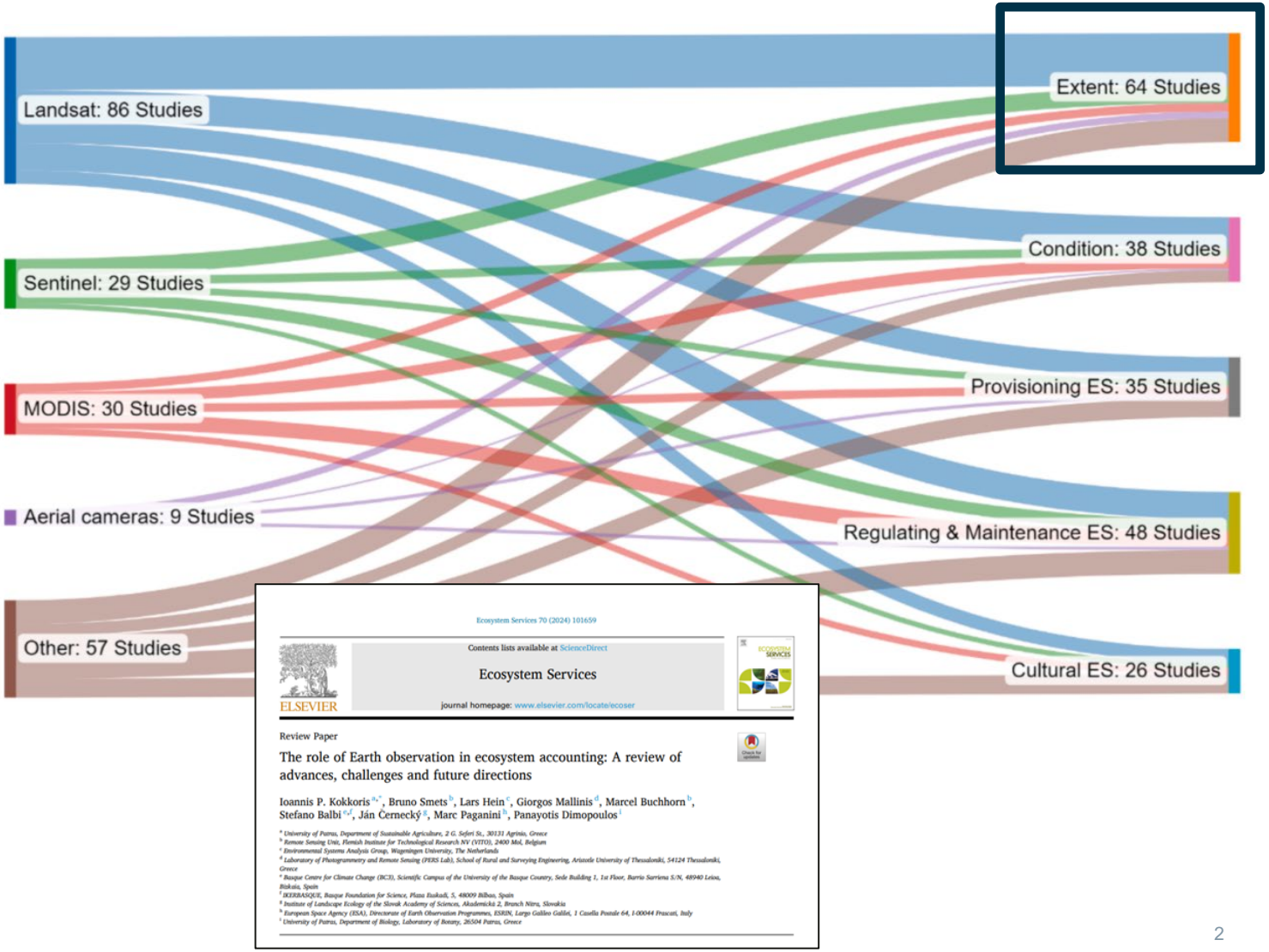
State of the Art review

Key findings and main challenges for EO based ecosystem extent accounting:

- EO data and products include available time-series with land use changes among different years to support ecosystem extent accounts.
- Limitations are noted for EO use to create extent accounts, related to: (a) the use of diverse input data, (b) accuracy variability over different areas and different classes, (c) coarse update intervals and outdatedness in comparison to the real world.
- The development of EO based workflows and pipelines specifically for ecosystem extent mapping and monitoring, based on standardized class schemes (i.e., EUNIS or IUCN GET) would be beneficial for the wider uptake of such approaches.



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Review Paper

The role of Earth observation in ecosystem accounting: A review of advances, challenges and future directions

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Ecosystem extent mapping in the PEOPLE EA Project

Ecosystem extent account : “Record the *area and change in area* for each ecosystem type within the national territory and shall be *reported in thousand hectares*. The account is complemented by a conversion matrix recording conversions between ecosystem types between two points in time.”

- **EU Extent typology**: is based on Corine, MAES & EUNIS, composed out of 3 levels (145 classes)

- **3 Approaches identified**:
  1. Derive from LC/LU (e.g. Corine) and CLMS datasets = **Top-down** (continental)
  2. Derive from several National datasets = **Bottom-up** (national)
  3. Derive from vegetation maps and complement for LC/LU = **Veg-centric** (continental per EnvZone)

- **PEOPLE-EA explore** Veg-centric approach, based on EUNIS habitat maps and complemented with other Land Cover / Land Use datasets for mainly non-vegetated types.

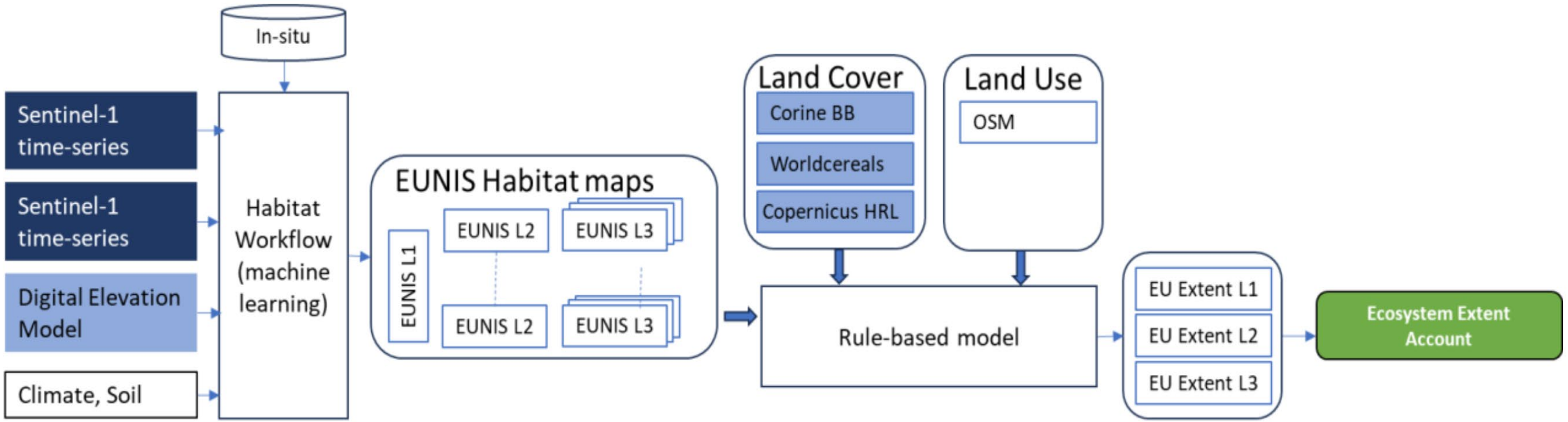
Pilot demonstrators & Early adopters

Country	Details / Indicator	Years (requested)	Co-design
Greece	**Mapping habitat types at level 2 in the Peloponnesus, and at level 3 in the coastal zone of the Peloponnesus**	**2020**	**X**
Netherlands	Habitat mapping: comparison of new habitat map and ecosystem type map of the Netherlands SEEA EA accounts	2021	
Norway	Mapping rural ecosystem extent in 3 counties (tentatively Møre og Romsdal, Trøndelag, Oslo Og Viken; Mapping urban and peri-urban extent	2021	
Slovakia	**Mapping ecosystem extent in the country**	**2020 (2015-2022)**	**X**

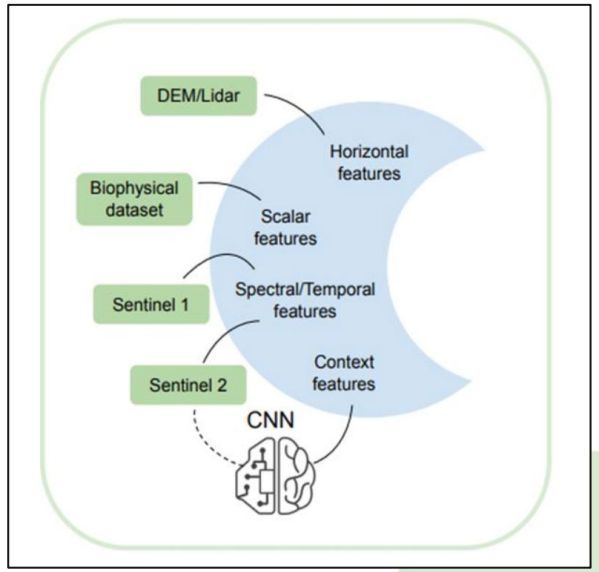
Workflow diagram for EU extent accounts

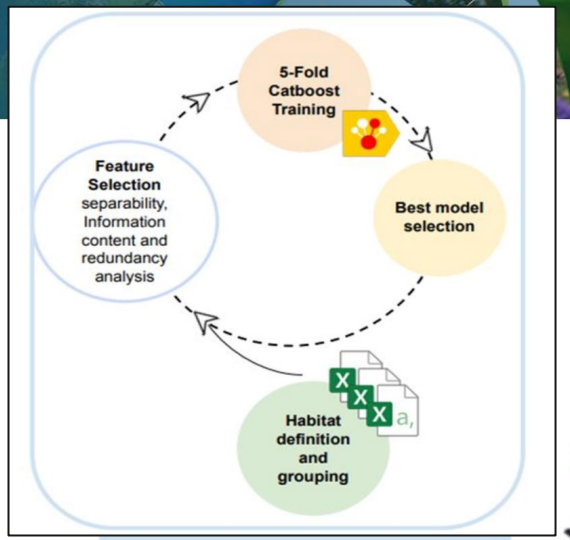
PEOPLE-EA explorer

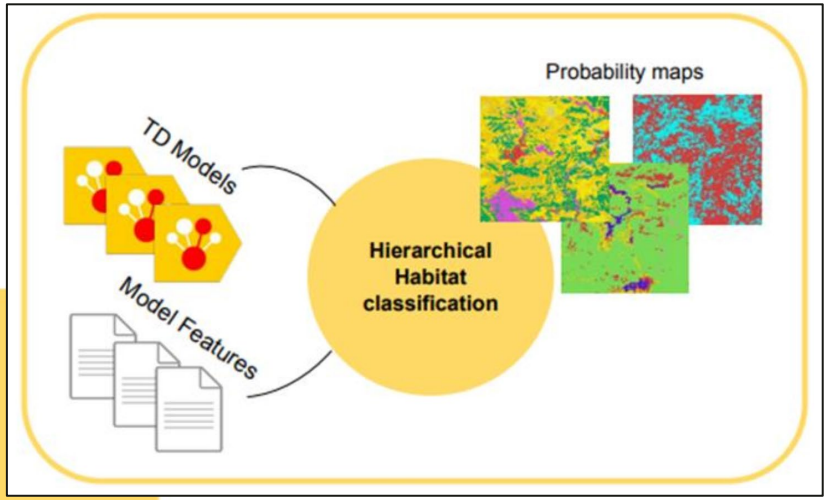
- High-Resolution (up to 10x10m)
- Up to level-3 (forest, coastal)
- Add quality layer (uncertainty)
- Change detection as independent flow
- Crosswalks to IUCN-GET typology



Terrestrial habitat mapping workflow







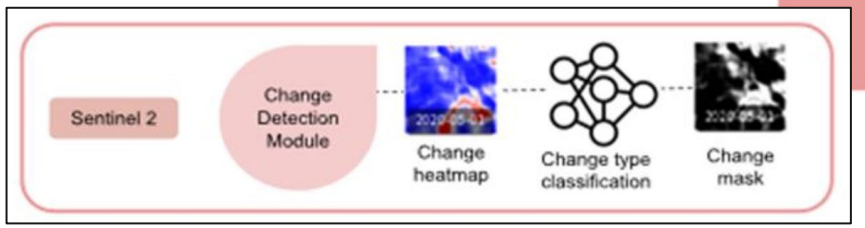
Feature Extraction Module

Feature Selection and Training Module

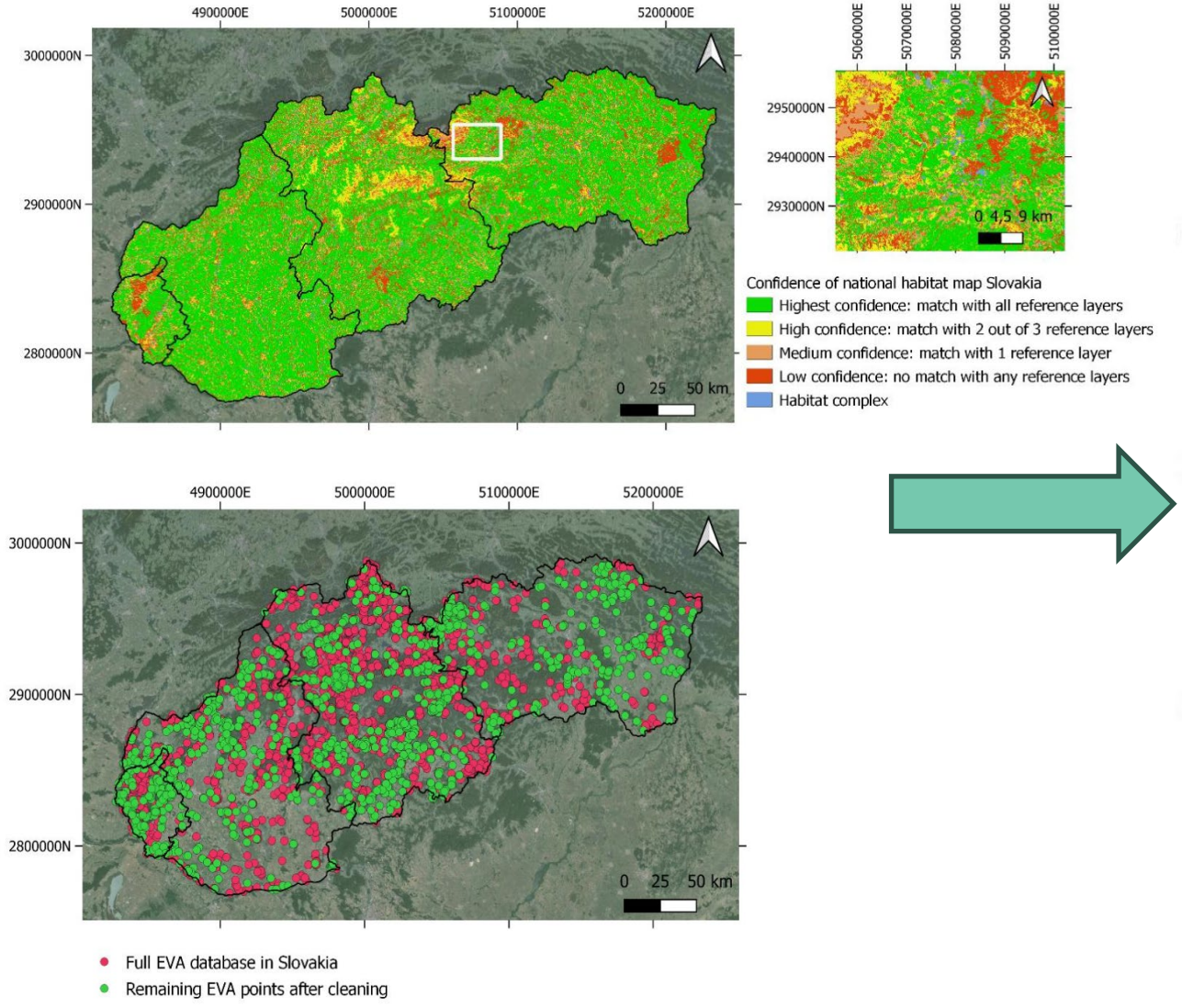
Inference Module

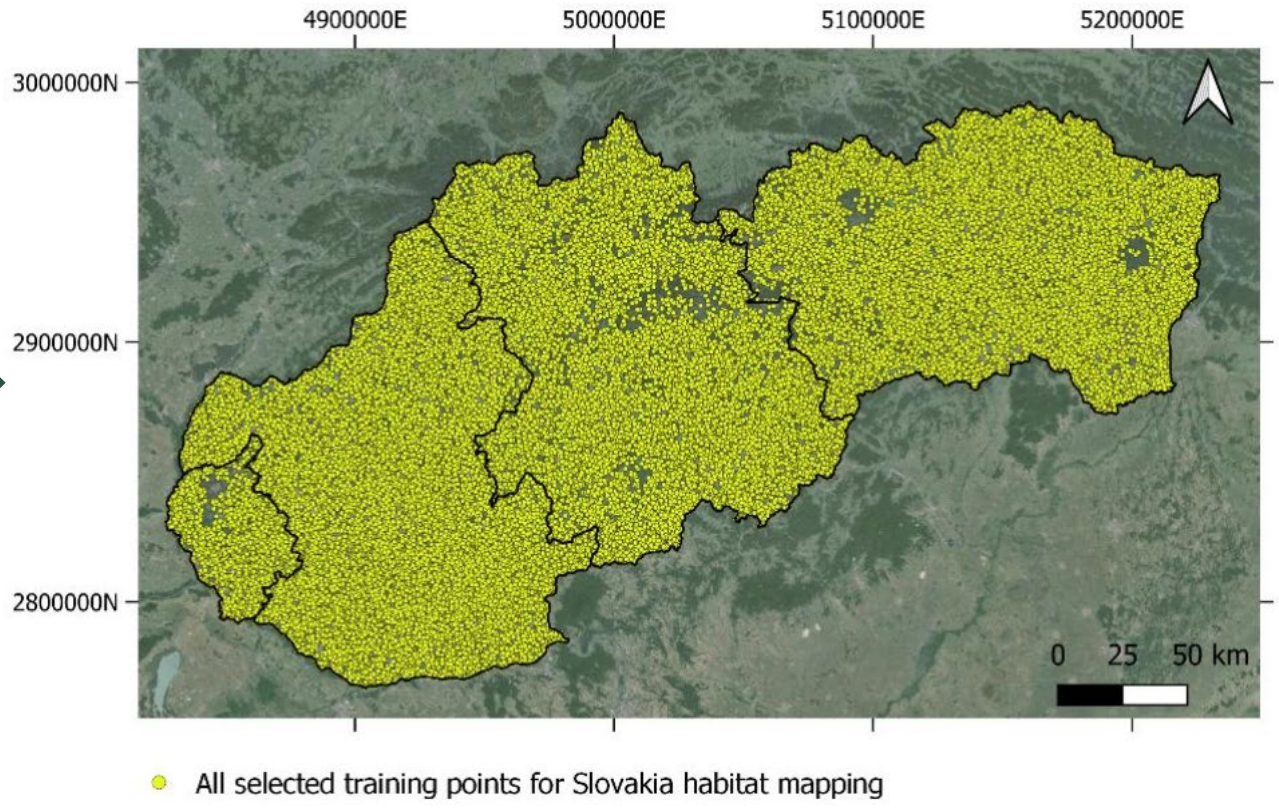
Post-Processing Module

Change Detection Module

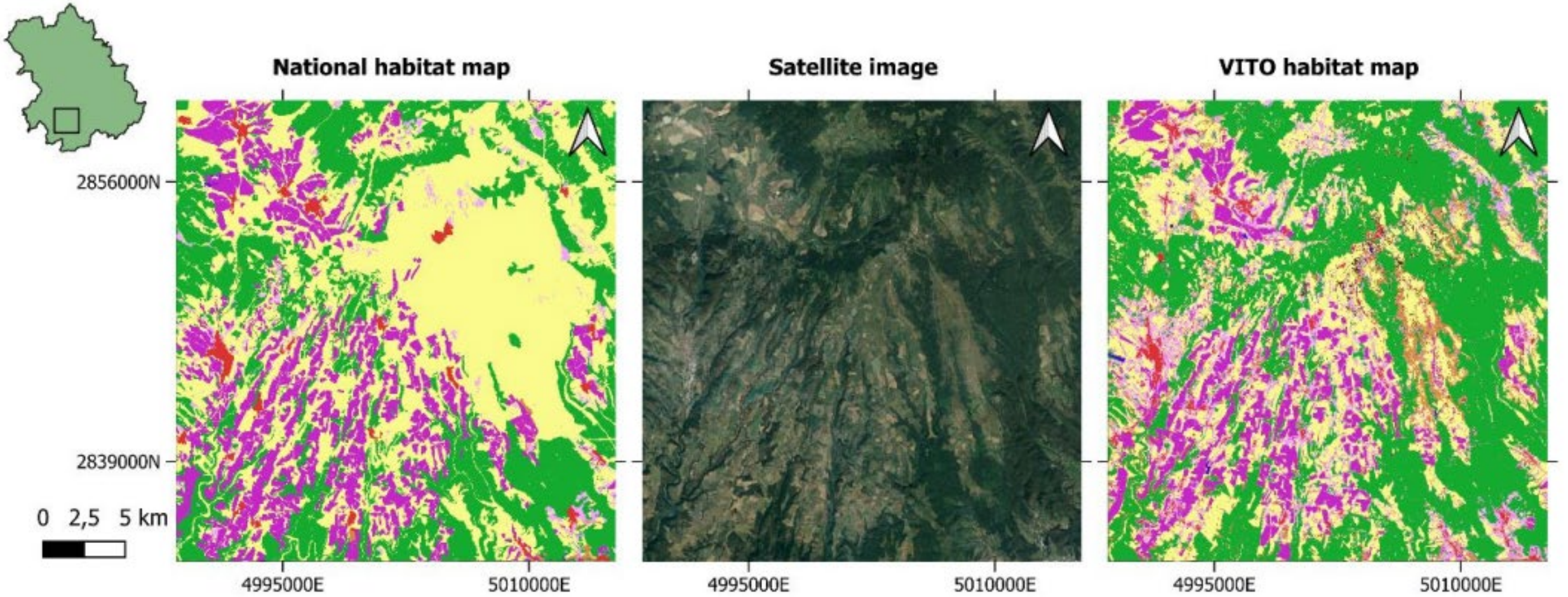


Slovakia: reference data preparation

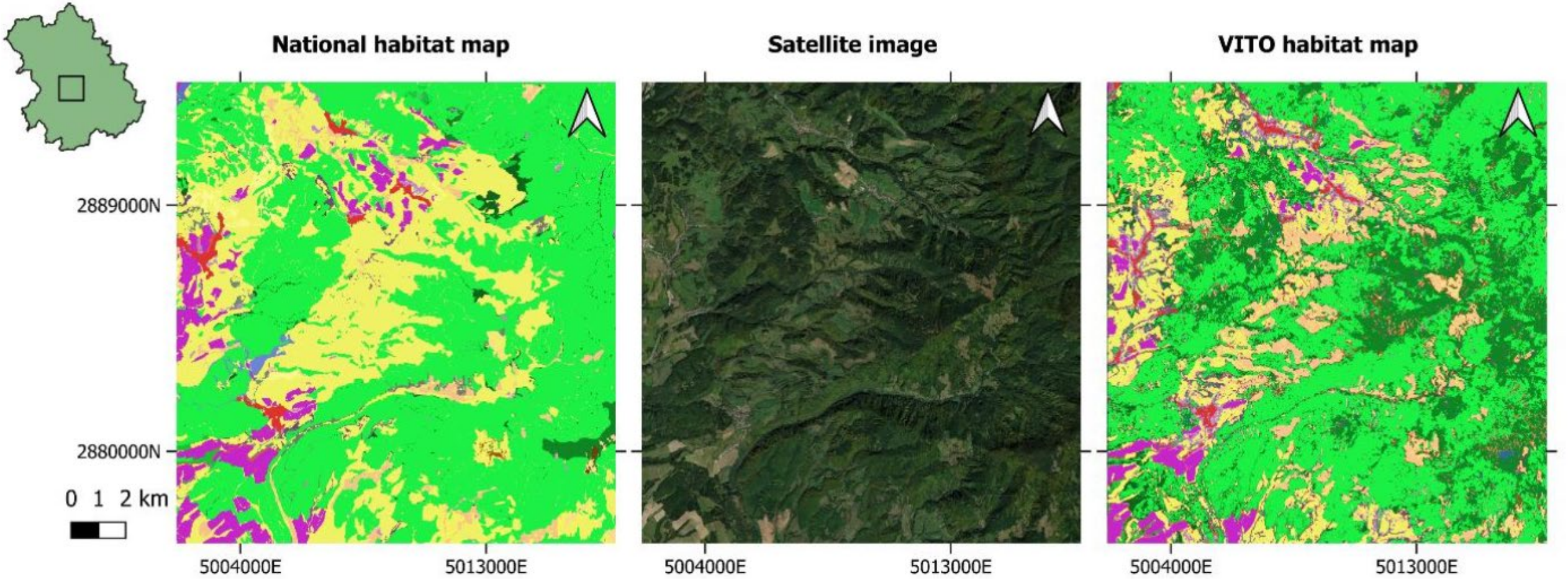




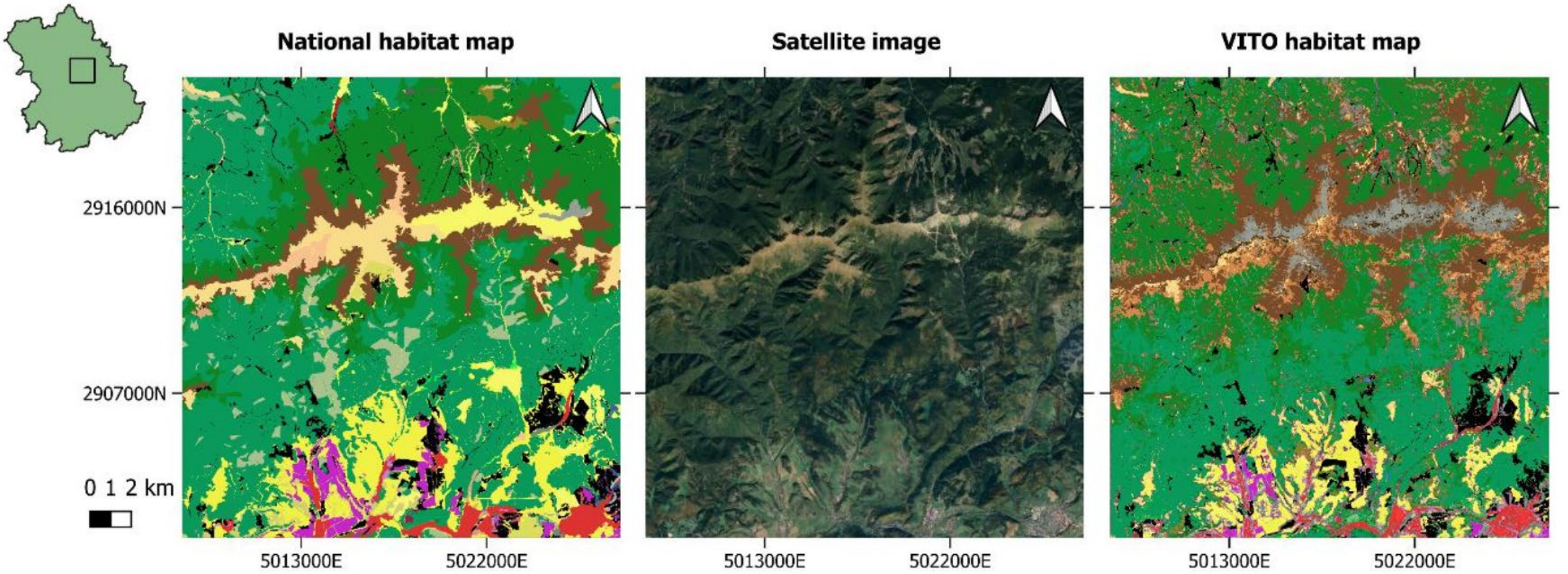
Slovakia: results EUNIS L1



Slovakia: results EUNIS L2

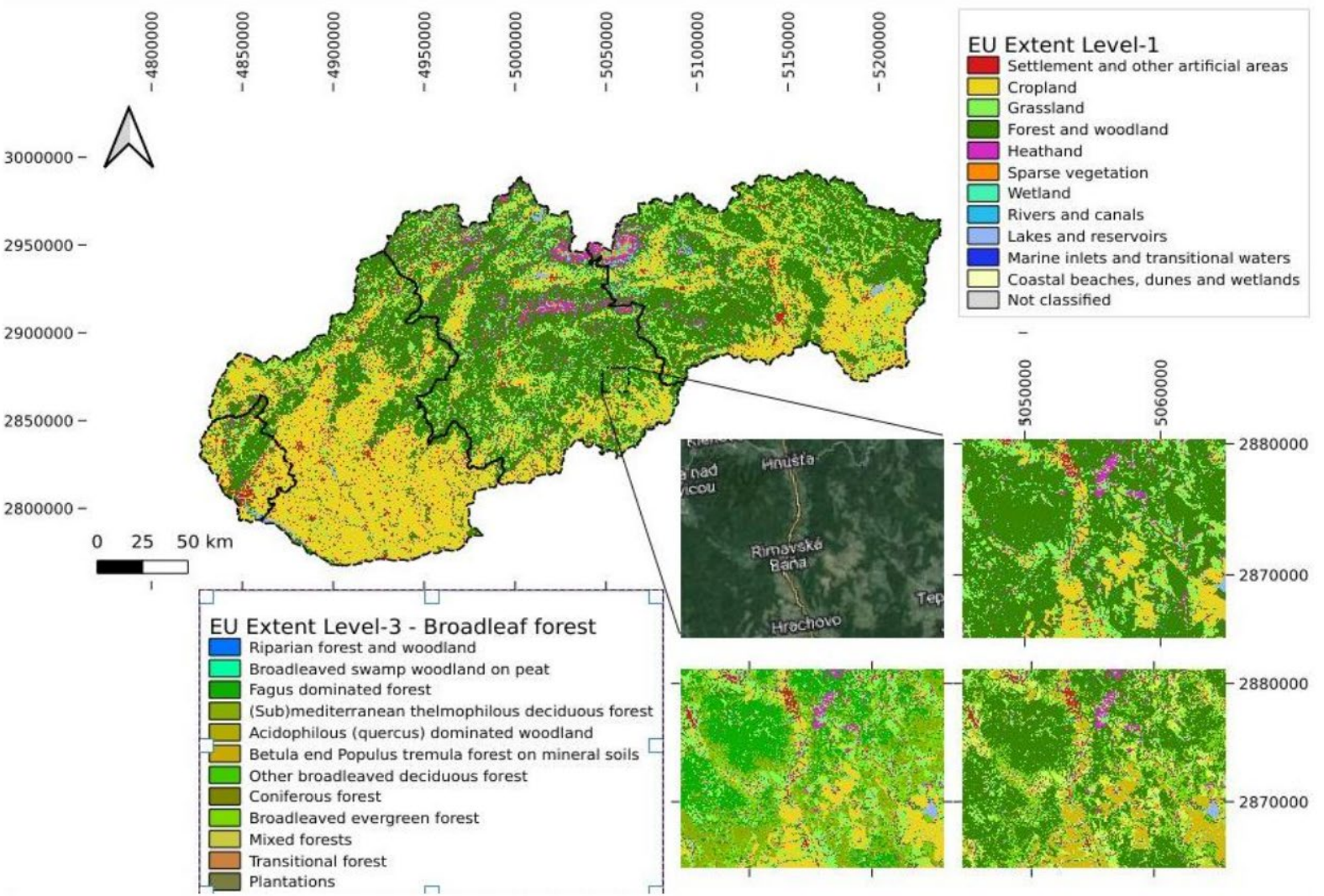


Slovakia: results EUNIS L3



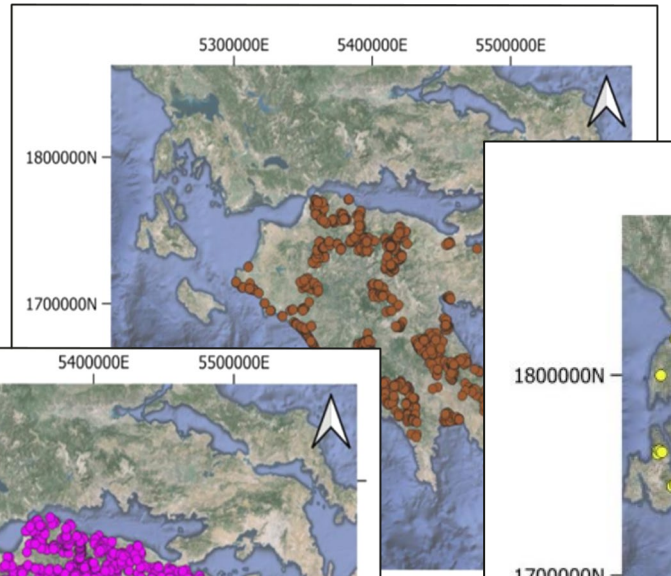
Slovakia: extent account

- We reached > 90% accuracy for natural classes, except for the wetlands and wet forests (~ 65%); quantified on some reference sites with ground-truth data.

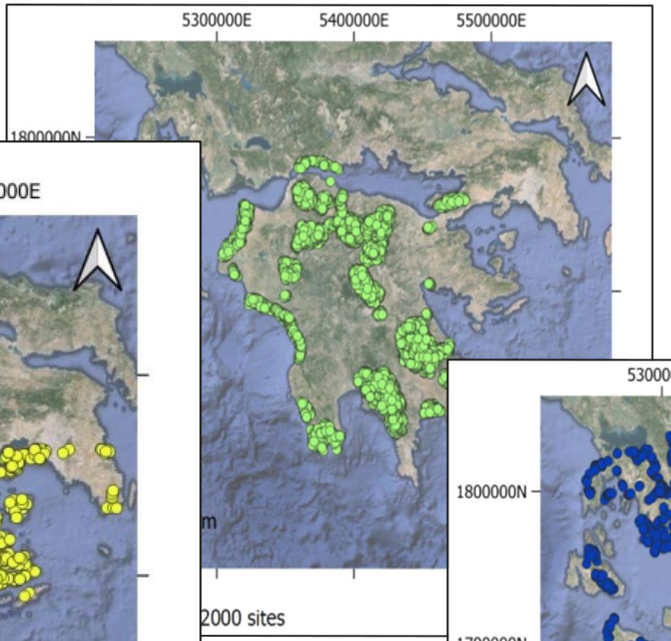


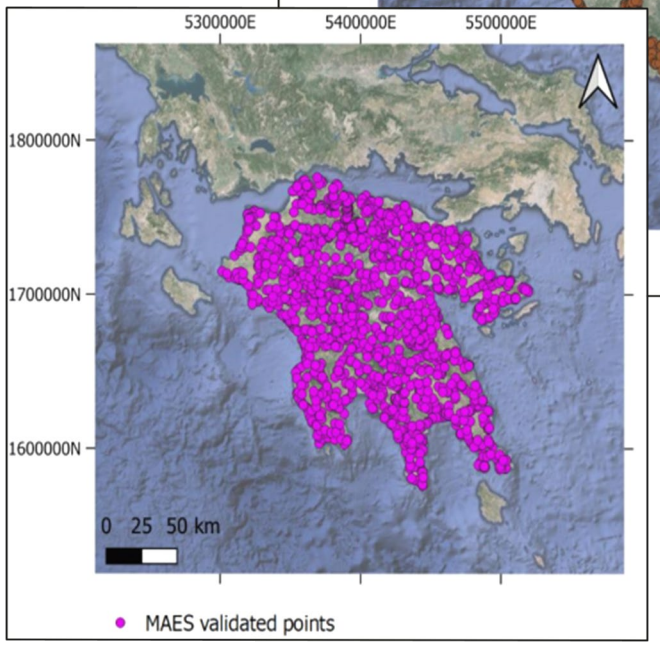
Greece: reference data preparation

Natura 2000 monitoring plots

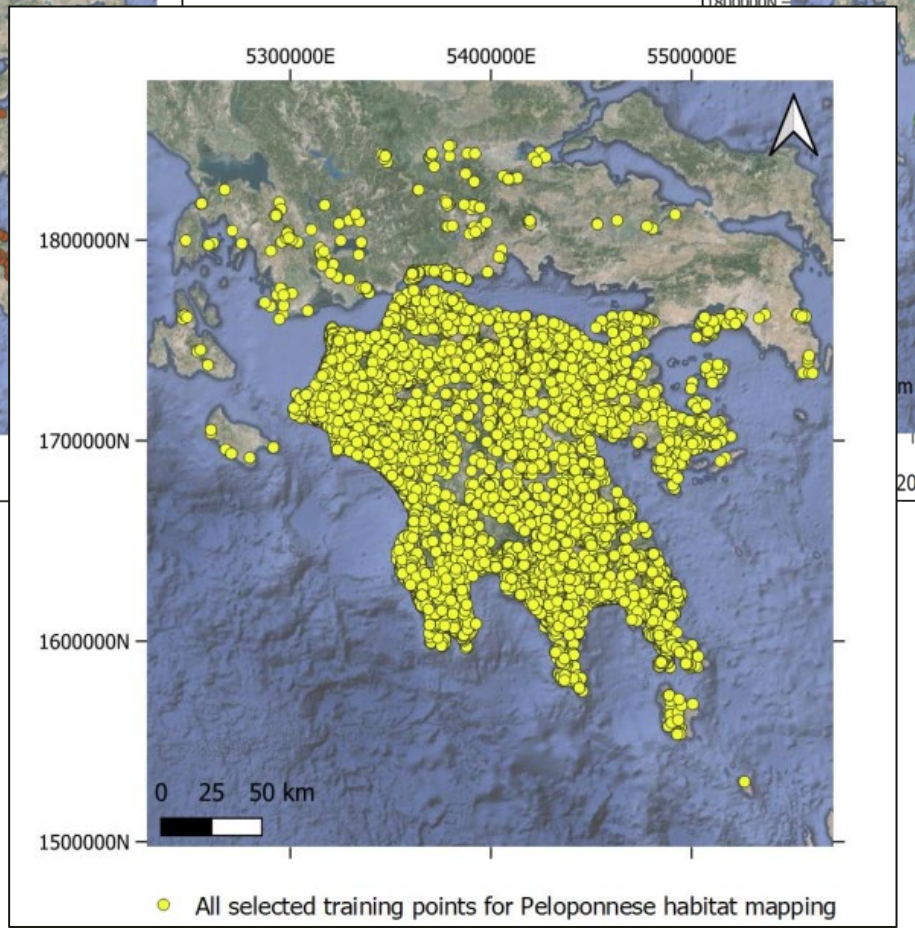


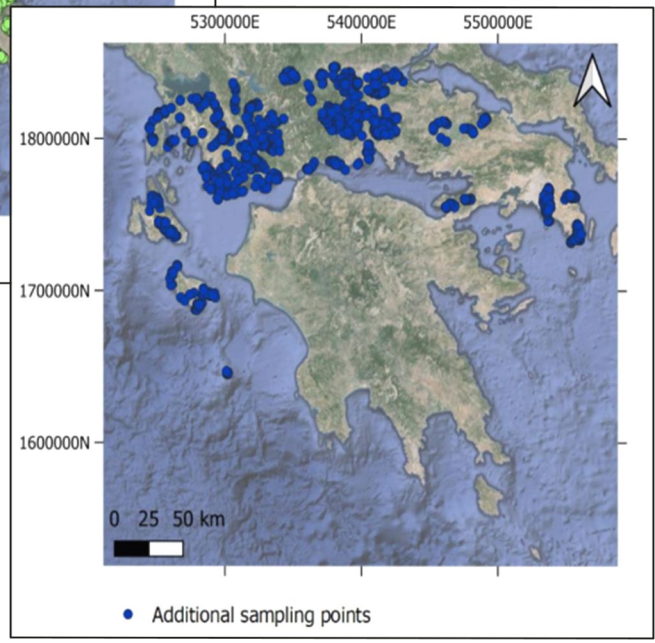
Natura 2000 points from polygons





MAES plots (LIFE IP 4 NATURA)





Additional plots

Greece: results – EUNIS L2

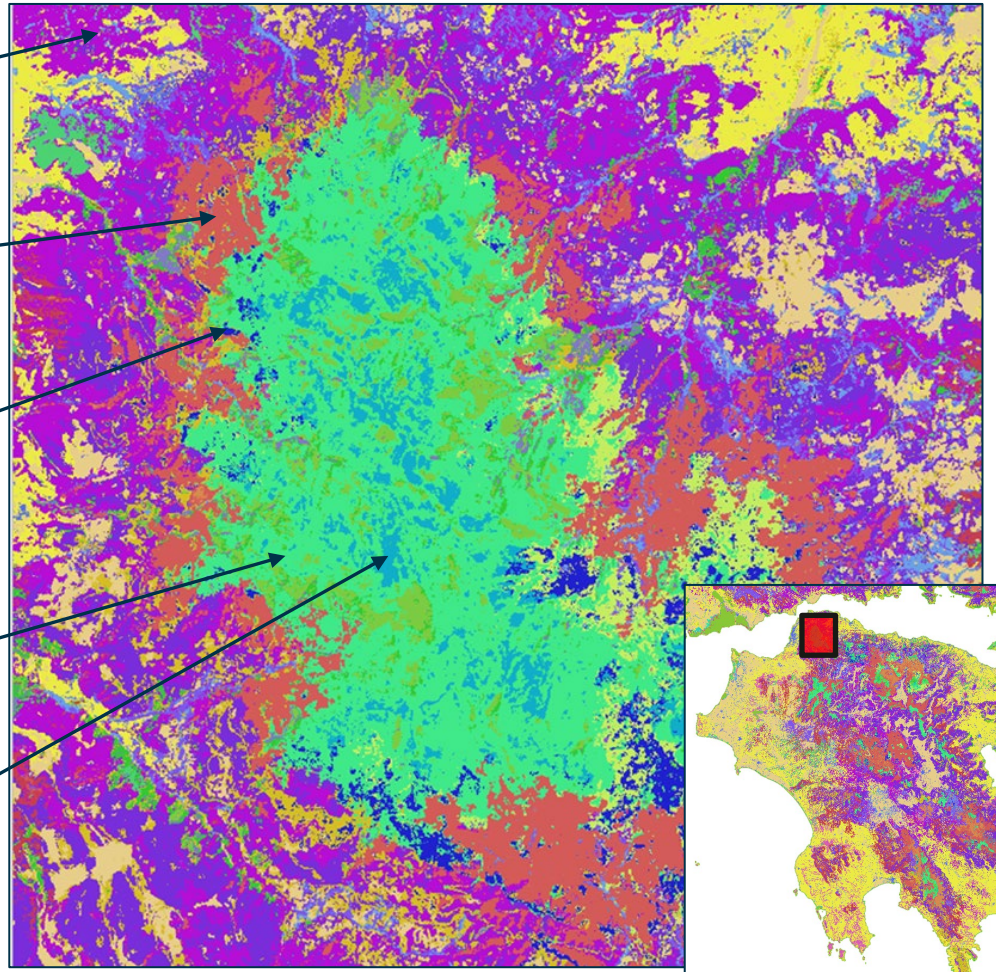
Mediterranean evergreen Quercus forest (Greece)

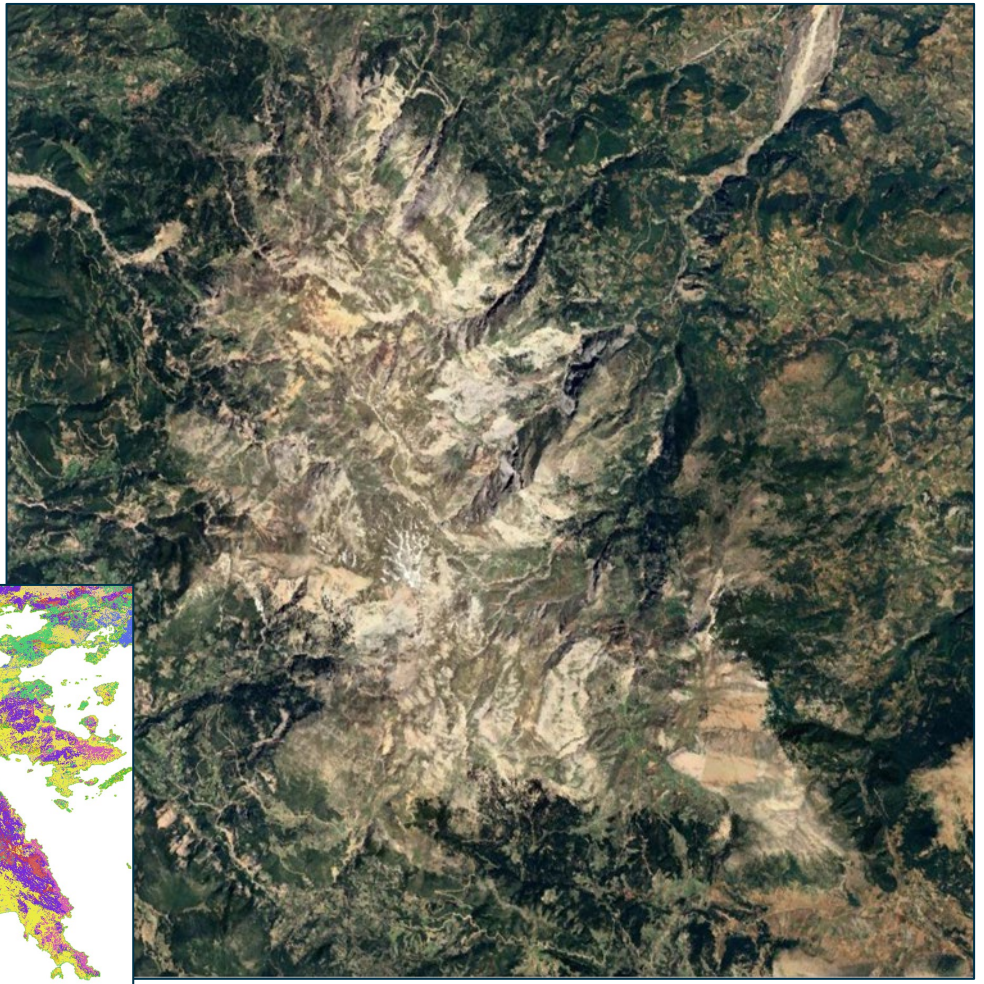
Mediterranean mountain *Abies* forest (Greece)

Mediterranean closely grazed dry grassland

Eastern Mediterranean mountain hedgehog-heath

Balkan and Anatolian oromediterranean dry grassland





Greece: results – EUNIS L2

Olea europaea-Ceratonia siliqua forest

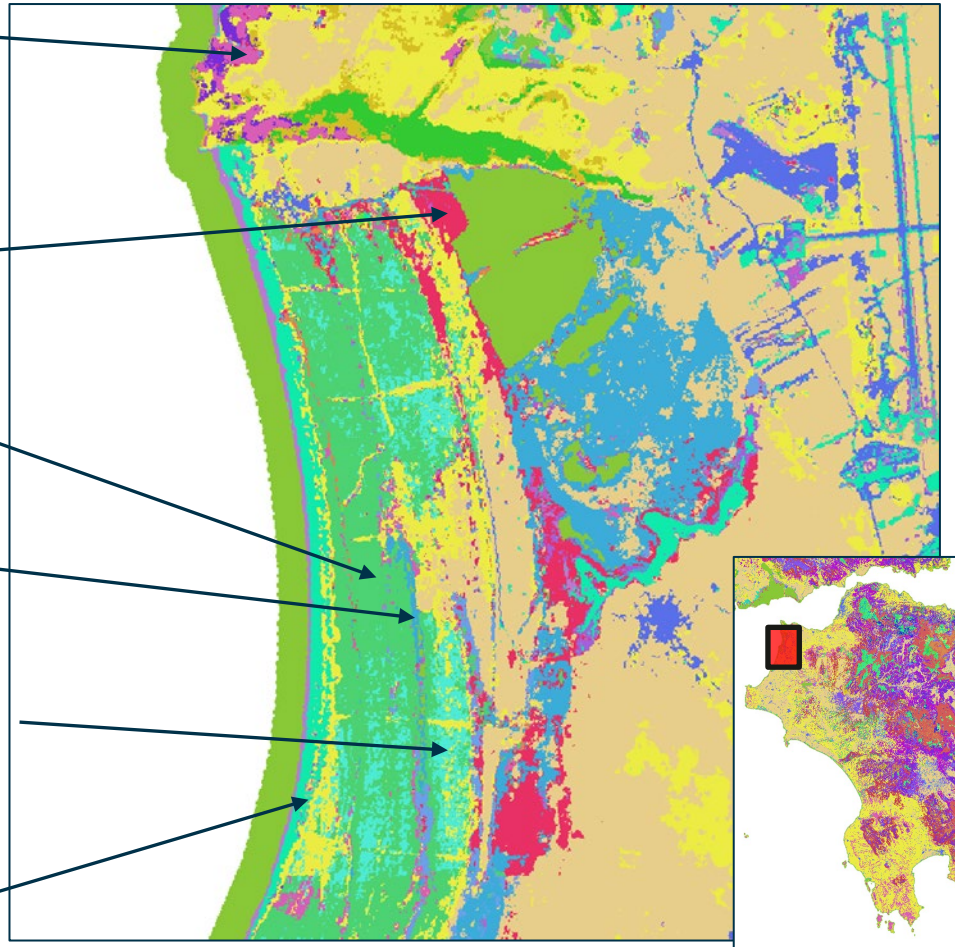
Mediterranean inland salt steppe

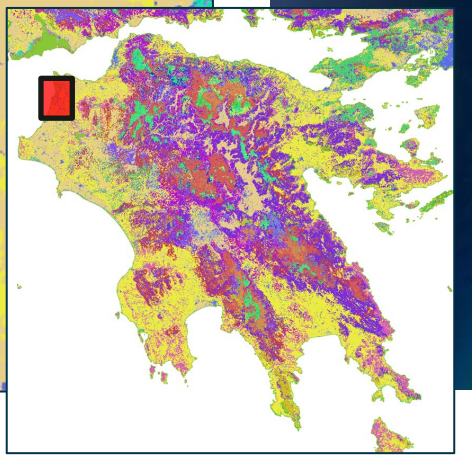
Mediterranean lowland to submontane *Pinus* forest

Tall-sedge bed

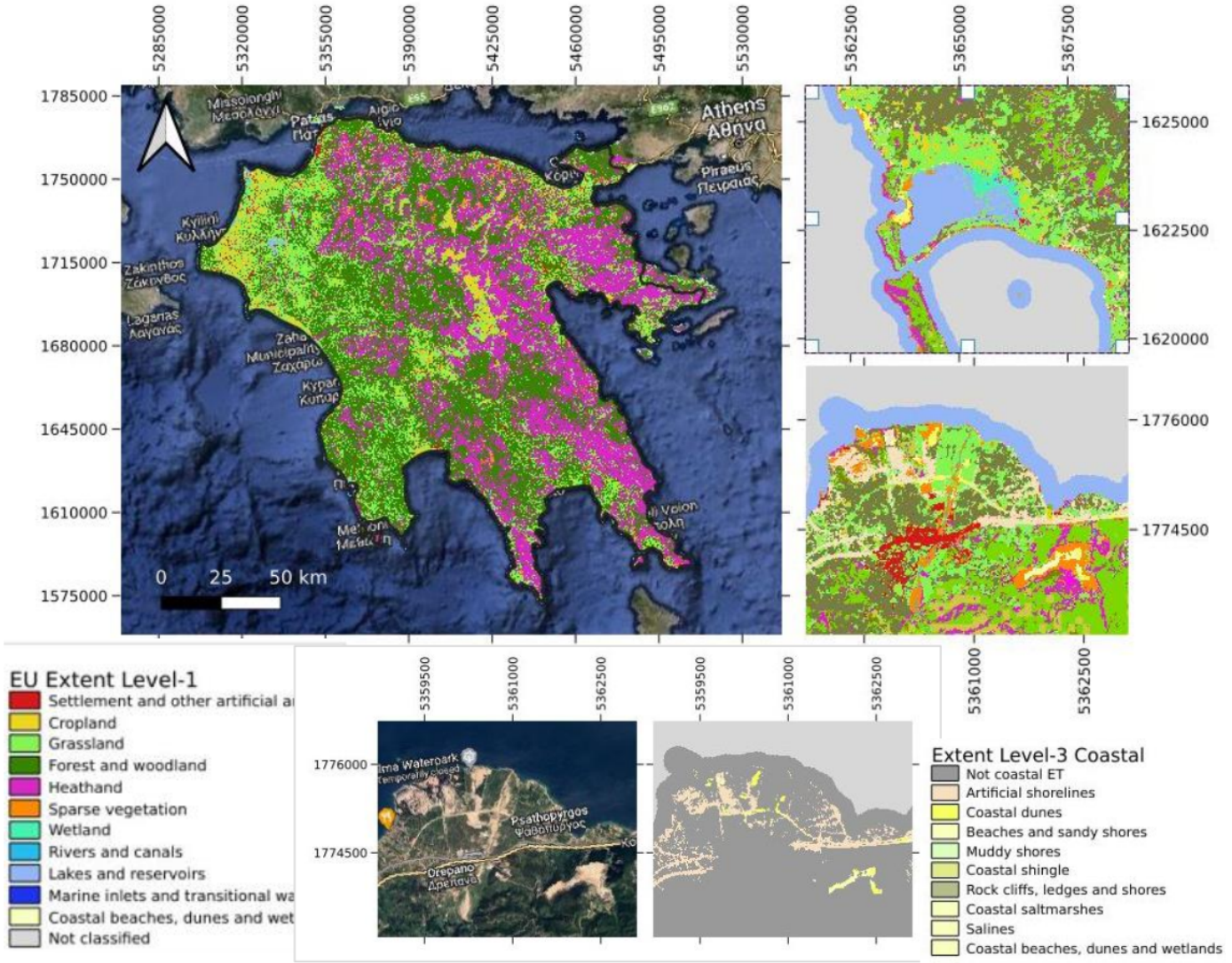
Mediterranean and Black Sea coastal dune scrub

Mediterranean, Macaronesian and Black Sea shifting coastal dune





Greece (Peloponnese): extent account



value	Ecosystem Type	Opening area (ha)	Additions	Reductions	Net changes	Closing area 2020 V3_1 (ha)	Share of closing area
	Outside accounting area						
1	Settlements and other artificial areas					35,784	1.6%
2	Cropland					96,318	4.3%
3	Grassland					467,716	20.6%
4	Forest and woodland					875,869	38.7%
5	Heathland and shrub					689,007	30.4%
6	Sparsely vegetated ecosystems					30,539	1.3%
7	Inland wetlands					1,806	0.1%
8	Rivers and Canals					5,621	0.2%
9	Lakes and reservoirs					49,726	2.2%
10	Marine inlets and transitional waters					-	-
11	Coastal beaches, dunes, and wetlands					13,452	0.6%
12	Marine ecosystems					-	-
	Total Ecosystem Accounting Area					**2,265,838**	

value	Ecosystem Type	Opening area (ha)	Additions	Reductions	Net changes	Closing area (ha)	Share of closing area
	Outside accounting area					1321893	
11	*Coastal beaches, dunes, and wetlands - Totals*					*13,452*	*0.59%*
11.0	*Unallocated L2*					-	*0.00%*
11.1	*Artificial shorelines*					*9,867*	*0.44%*
11.1.0	*Unallocated L3*					-	*0.00%*
11.1.1	Artificial shorelines					9,867	*0.44%*
11.2	*Coastal dunes, beaches and sandy and muddy shores*					*3,445*	*0.15%*
11.2.0	*Unallocated L3*					801	*0.04%*
11.2.1	Coastal dunes					2,214	*0.10%*
11.2.2	Beaches and sandy shores					429	*0.02%*
11.2.3	Muddy shores					-	*0.00%*
11.3	*Coastal rocky shores*					*140*	*0.01%*
11.3.0	*Unallocated L3*					140	*0.01%*
11.3.1	Coastal shingle					-	*0.00%*
11.3.2	Rock cliffs, ledges and shores					-	*0.00%*
11.4	*Coastal saltmarshes and salines*					*0*	*0.00%*
11.4.0	*Unallocated L3*					-	*0.00%*
11.4.1	Coastal saltmarshes					-	*0.00%*
11.4.2	Salines					-	*0.00%*

Key messages and future work

- The thematic detail and quality of the EUNIS habitat maps derived from Sentinel-1 and Sentinel-2 temporal aggregated data are very much relying on the quality of the training datasets, so special attention needs to be given to the gathering (or selection) of training points from different existing sources.
- It is proposed to follow a dual approach, combining the deep learning and traditional approach and investigate its overlap and complementary for change detection **->** *Develop a protocol to map changes in ecosystem extent (assuring that only real changes are included in the accounts, not changes due to errors or biases in spatial data).*
- For non-natural classes, more land use information needs to be integrated
- Greece already integrated the results for designing a pilot accounting scheme for terrestrial ecosystems (WEED project objective).

NEXT STEPS

Develop and showcase a versatile and **globally applicable** innovative toolkit that utilizes Earth Observation data **to map and monitor their changes in extent** for terrestrial, freshwater, and coastal (up to the intertidal zones) **ecosystems**.

Thank you!

vito remote sensing

bc3 BASQUE CENTRE FOR CLIMATE CHANGE Klima Aldaketa Ikergai Sustainability, that's it!

Ecounting

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