# A Forest Ecosystem Condition Account For Europe Based On Earth Observation Data

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Why developing a European forest account

- To assess forest degradation – to guide forest restoration plans (EU's proposal for a nature restoration law)

- To support the forest economy

- To assess options for climate mitigation (carbon sink) and climate adaptation (water retention, water provision, cooling)

The assessment of forest ecosystem condition followed rigorously the biophysical guidelines of the SEEA EA framework (Chapter 5). Under this framework, **ecosystem condition is defined as the quality of an ecosystem measured in terms of its abiotic and biotic characteristics.**

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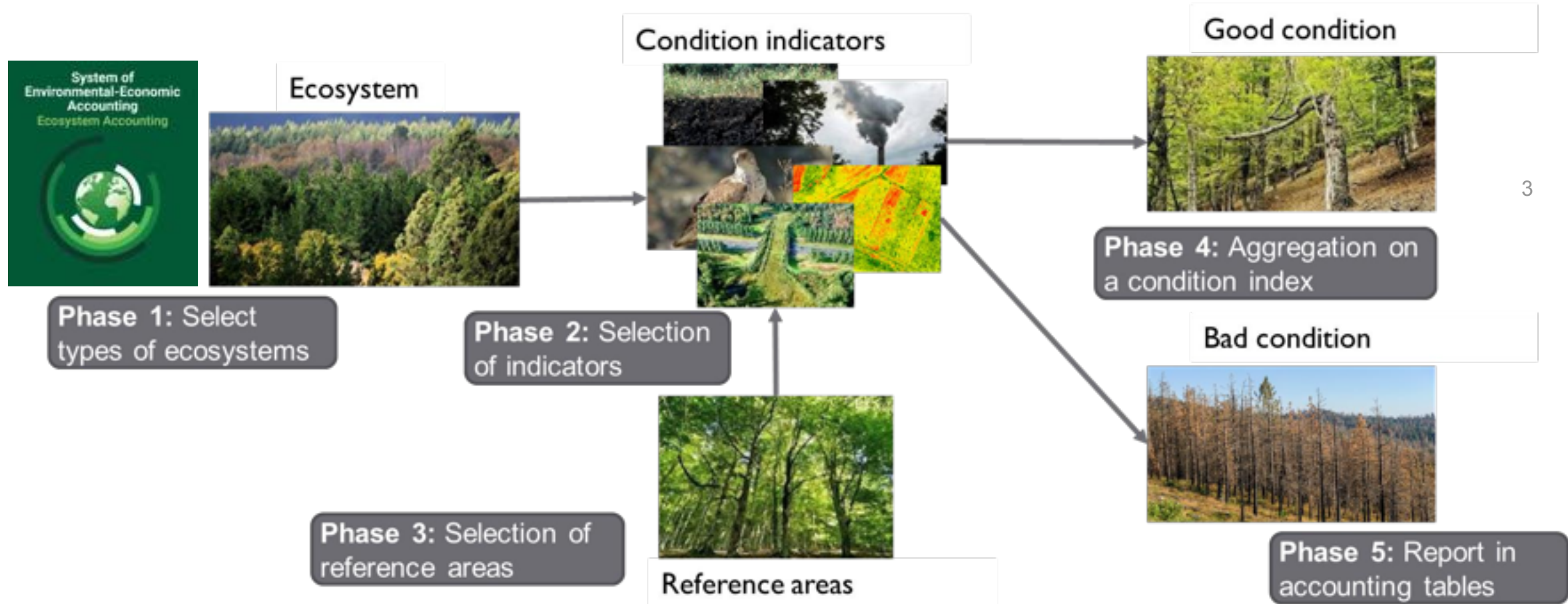
Forest ecosystem typology
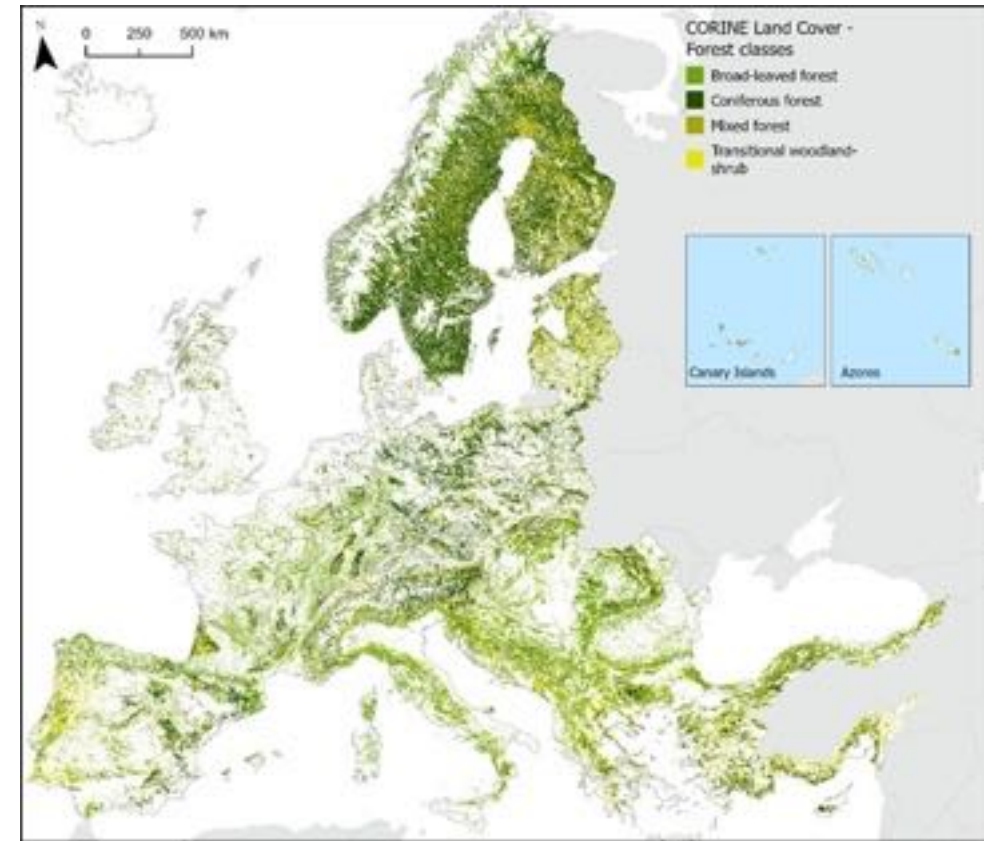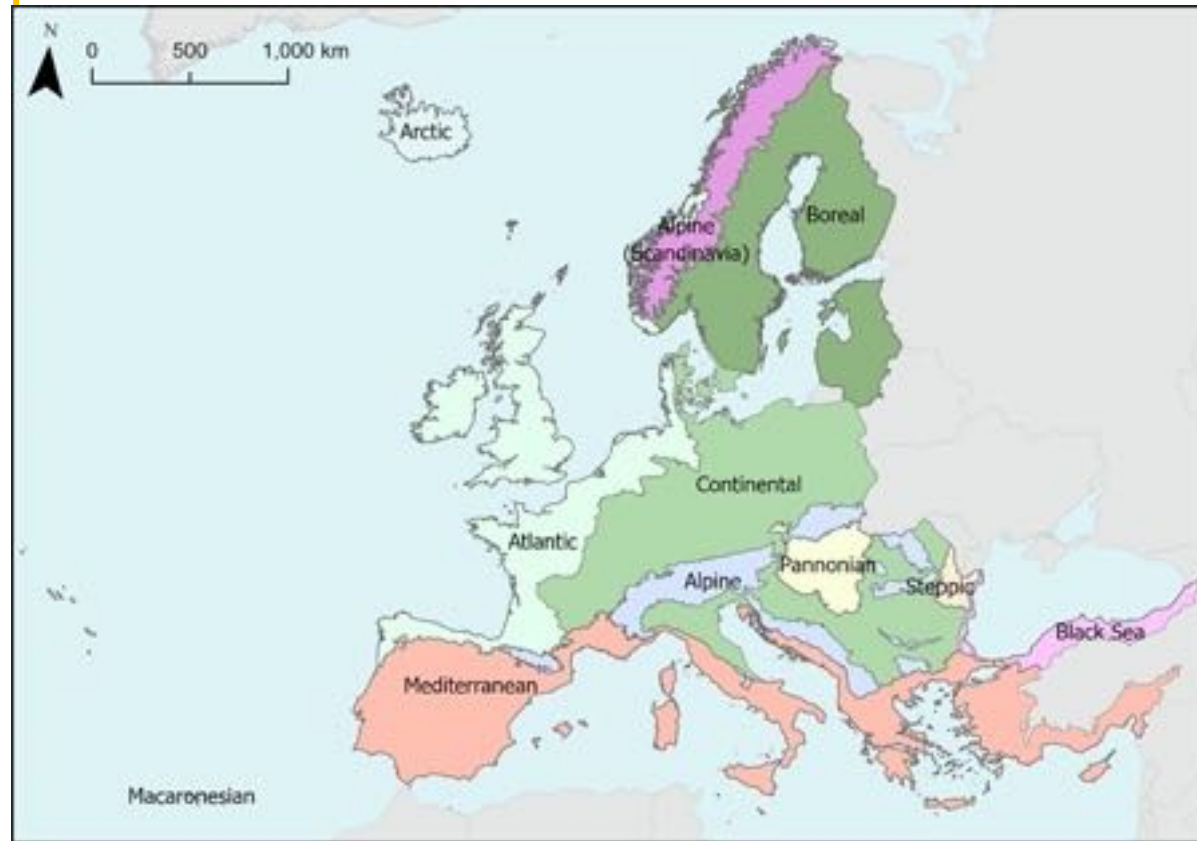
11 Biogeographical Regions +   4 Land Cover classes
2000 – 2018
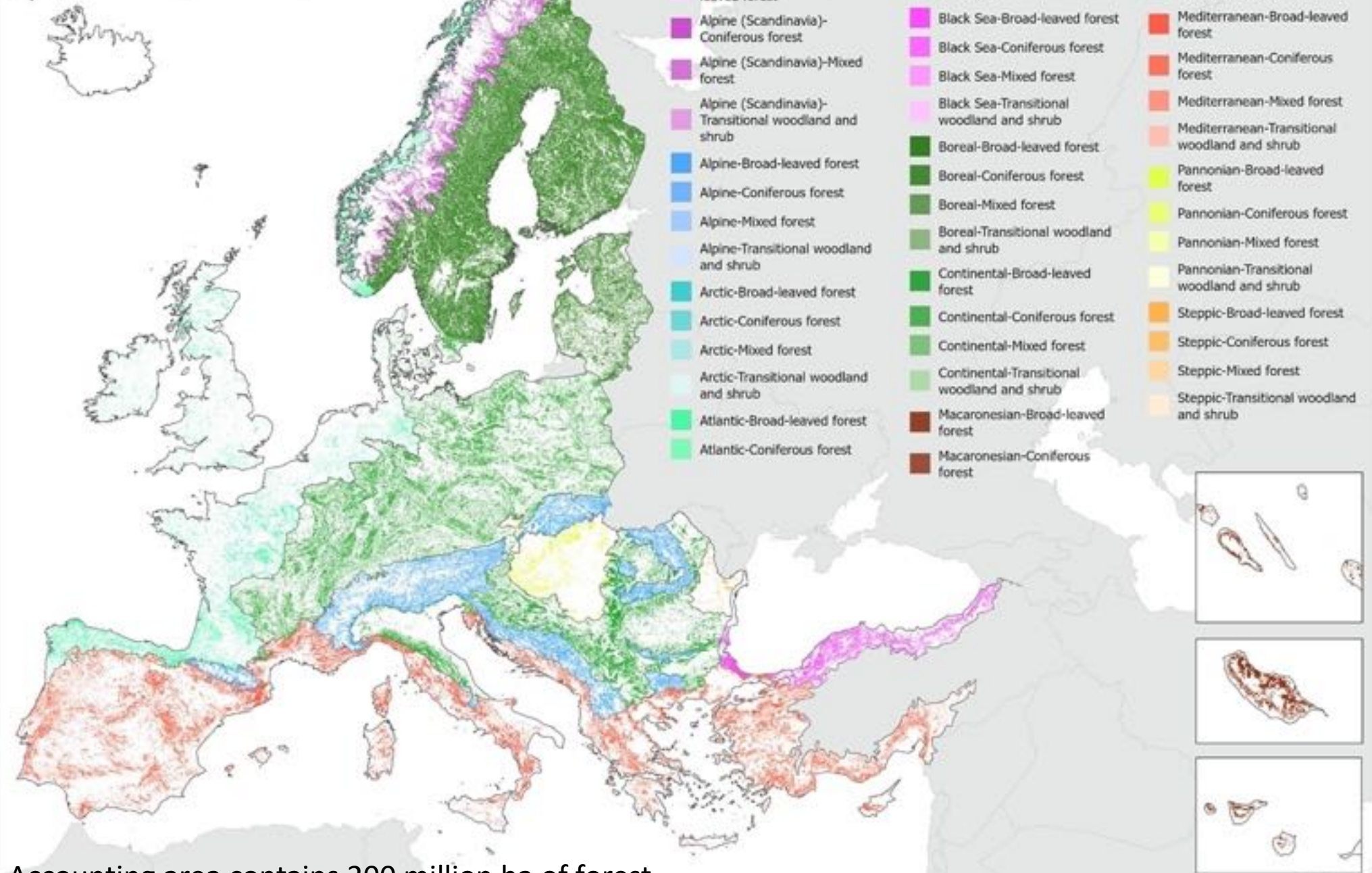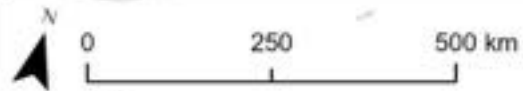
Forest ecosystem types

- Alpine (Scandinavia)-Broad-leaved forest
- Alpine (Scandinavia)-Coniferous forest
- Alpine (Scandinavia)-Mixed forest
- Alpine (Scandinavia)-Transitional woodland and shrub
- Alpine-Broad-leaved forest
- Alpine-Coniferous forest
- Alpine-Mixed forest
- Alpine-Transitional woodland and shrub
- Arctic-Broad-leaved forest
- Arctic-Coniferous forest
- Arctic-Mixed forest
- Arctic-Transitional woodland and shrub
- Atlantic-Broad-leaved forest
- Atlantic-Coniferous forest
- Atlantic-Mixed forest
- Atlantic-Transitional woodland and shrub
- Black Sea-Broad-leaved forest
- Black Sea-Coniferous forest
- Black Sea-Mixed forest
- Black Sea-Transitional woodland and shrub
- Boreal-Broad-leaved forest
- Boreal-Coniferous forest
- Boreal-Mixed forest
- Boreal-Transitional woodland and shrub
- Continental-Broad-leaved forest
- Continental-Coniferous forest
- Continental-Mixed forest
- Continental-Transitional woodland and shrub
- Macaronesian-Broad-leaved forest
- Macaronesian-Coniferous forest
- Macaronesian-Mixed forest
- Macaronesian-Transitional woodland and shrub
- Mediterranean-Broad-leaved forest
- Mediterranean-Coniferous forest
- Mediterranean-Mixed forest
- Mediterranean-Transitional woodland and shrub
- Pannonian-Broad-leaved forest
- Pannonian-Coniferous forest
- Pannonian-Mixed forest
- Pannonian-Transitional woodland and shrub
- Steppic-Broad-leaved forest
- Steppic-Coniferous forest
- Steppic-Mixed forest
- Steppic-Transitional woodland and shrub

0   250   500 km

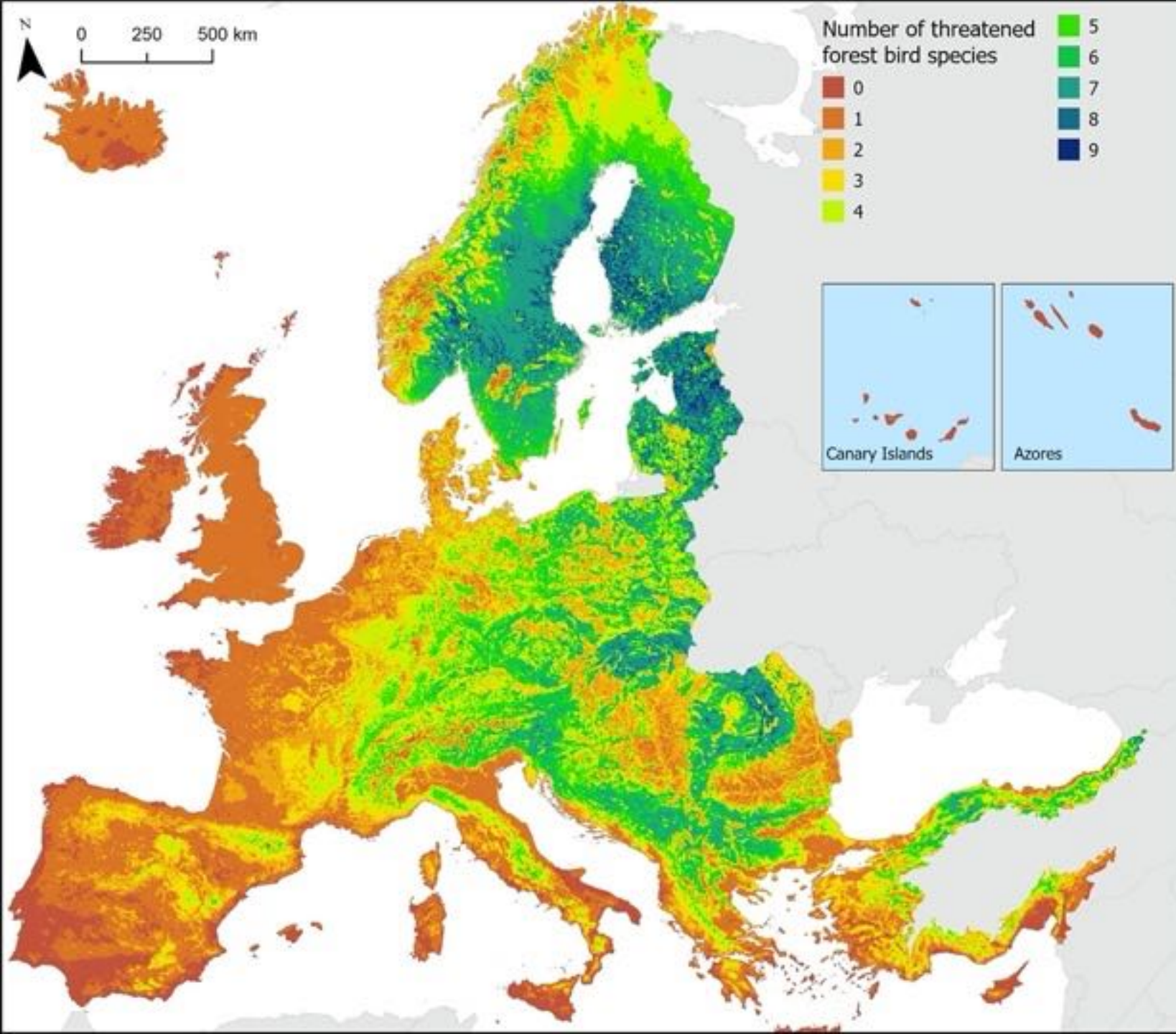Accounting area contains 200 million ha of forest
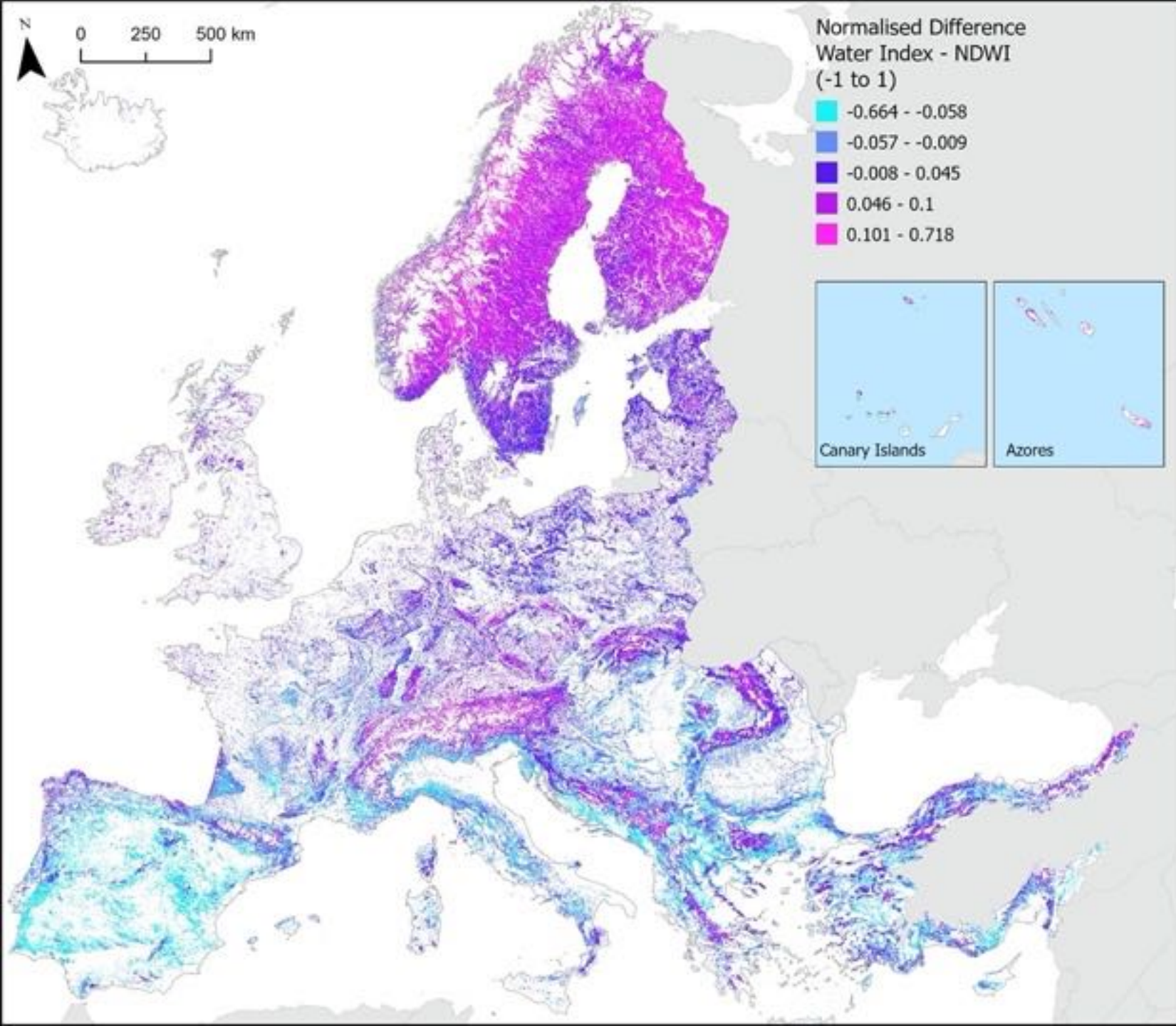
Forest condition variables
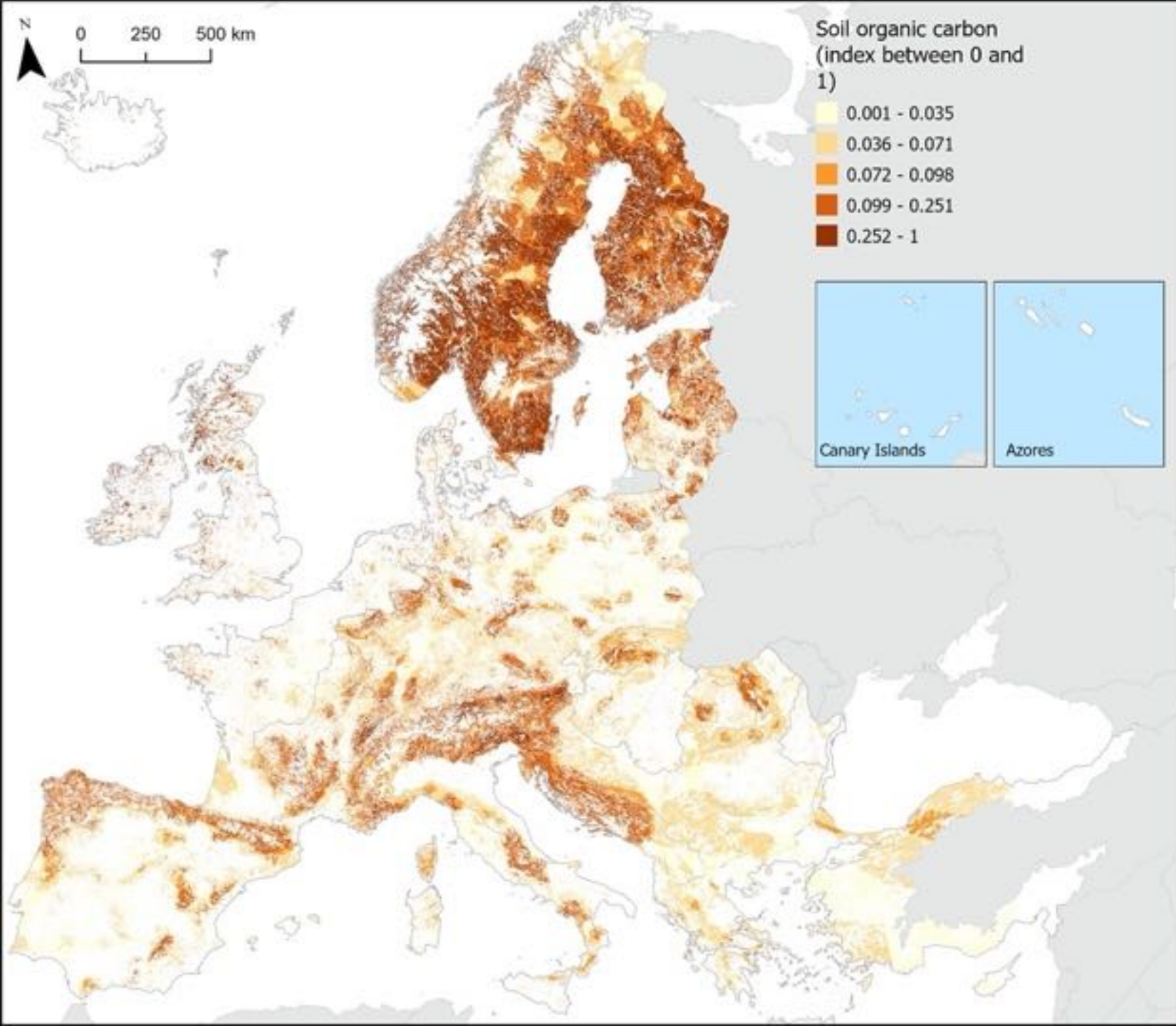
- Water content - Normalized difference water index (NDWI)
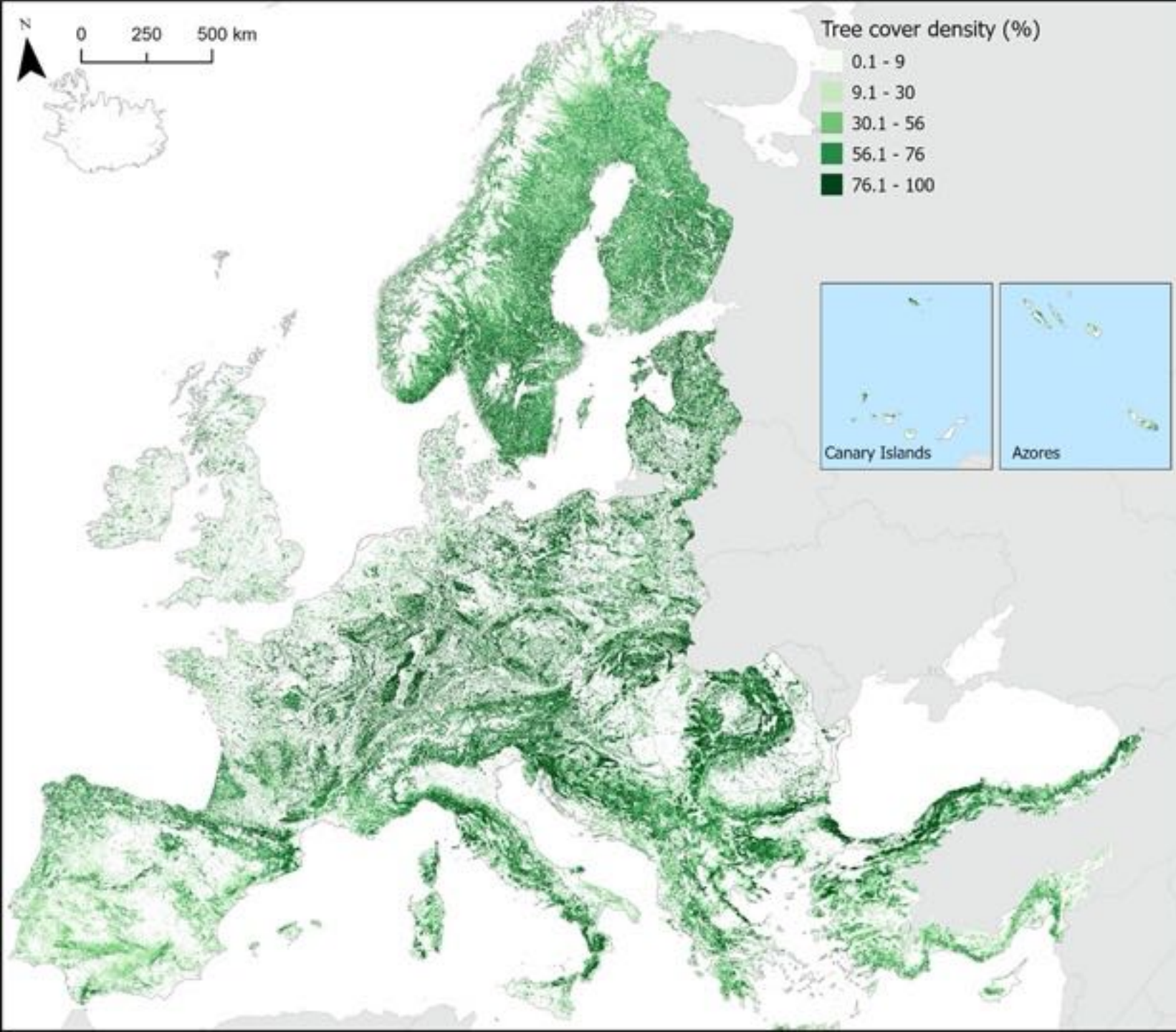
Forest condition variables

- Water content - Normalized difference water index (NDWI)

- Soil organic carbon

Number of threatened forest bird species
- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9

Canary Islands

Azores

Forest condition variables

- Water content - Normalized difference water index (NDWI)

- Soil organic carbon

- Species richness of threatened forest birds

European Commission

Forest condition variables

- Water content - Normalized difference water index (NDWI)

- Soil organic carbon

- Species richness of threatened forest birds
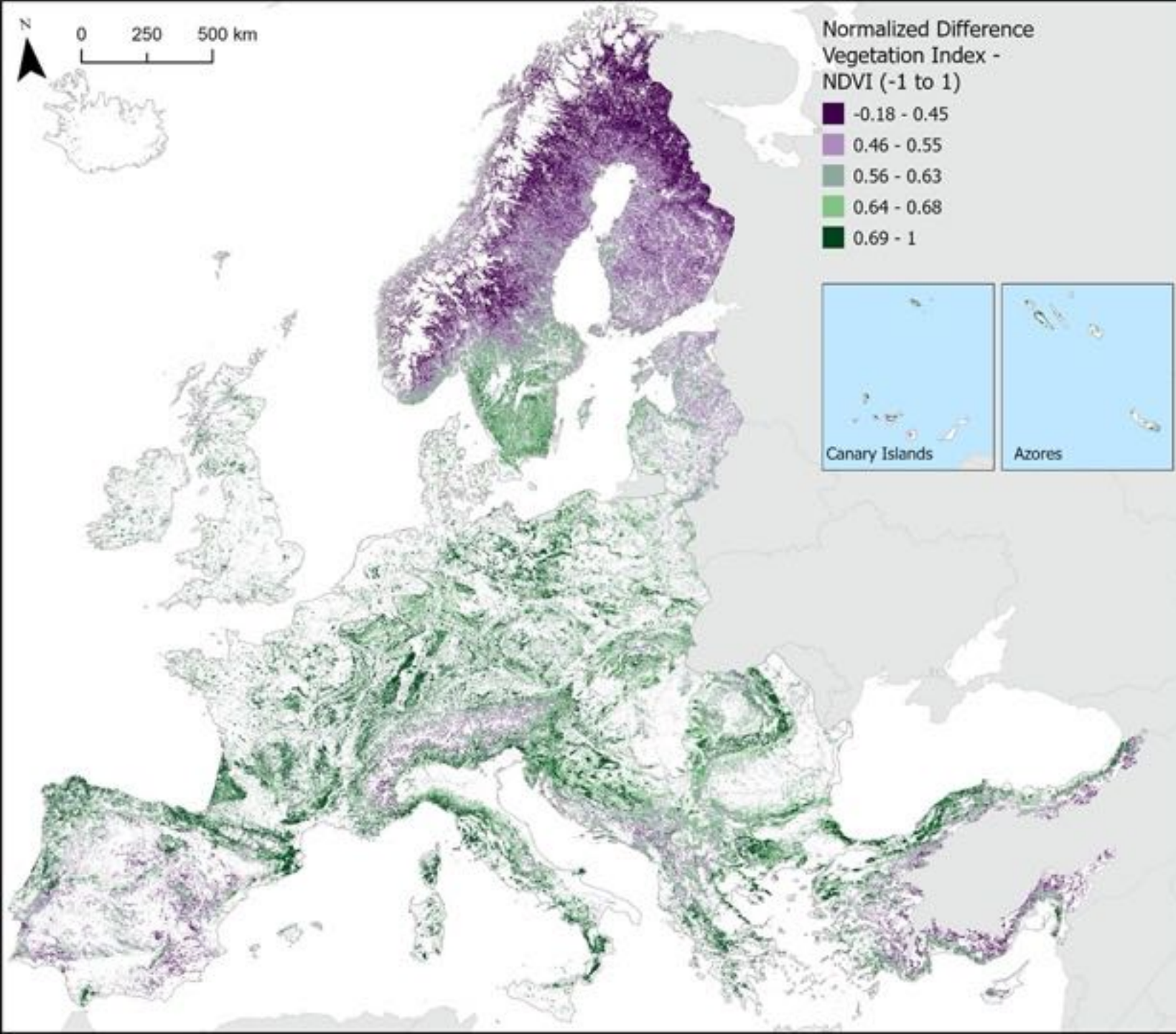
- Tree cover density

Forest condition variables

- Water content - Normalized difference water index (NDWI)

- Soil organic carbon

- Species richness of threatened forest birds

- Tree cover density

- Forest productivity - Normalized difference vegetation index (NDVI)

Normalized Difference Vegetation Index - NDVI (-1 to 1)

- -0.18 - 0.45
- 0.46 - 0.55
- 0.56 - 0.63
- 0.64 - 0.68
- 0.69 - 1

Canary Islands

Azores

Forest area density (%)
- 1 - 50
- 51 - 70
- 71 - 84
- 85 - 95
- 96 - 100

Canary Islands

Azores

Forest condition variables

- Water content - Normalized difference water index (NDWI)

- Soil organic carbon

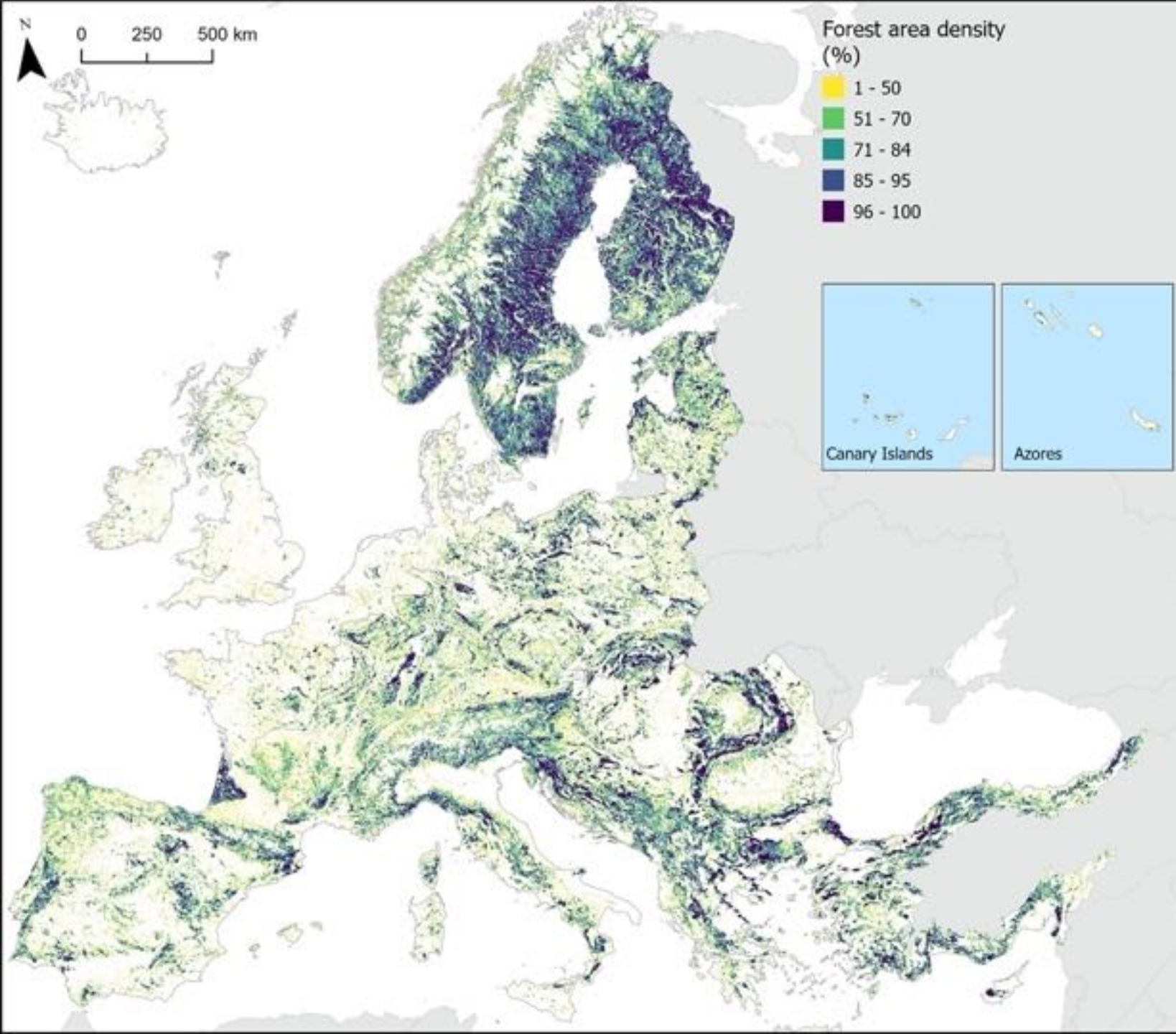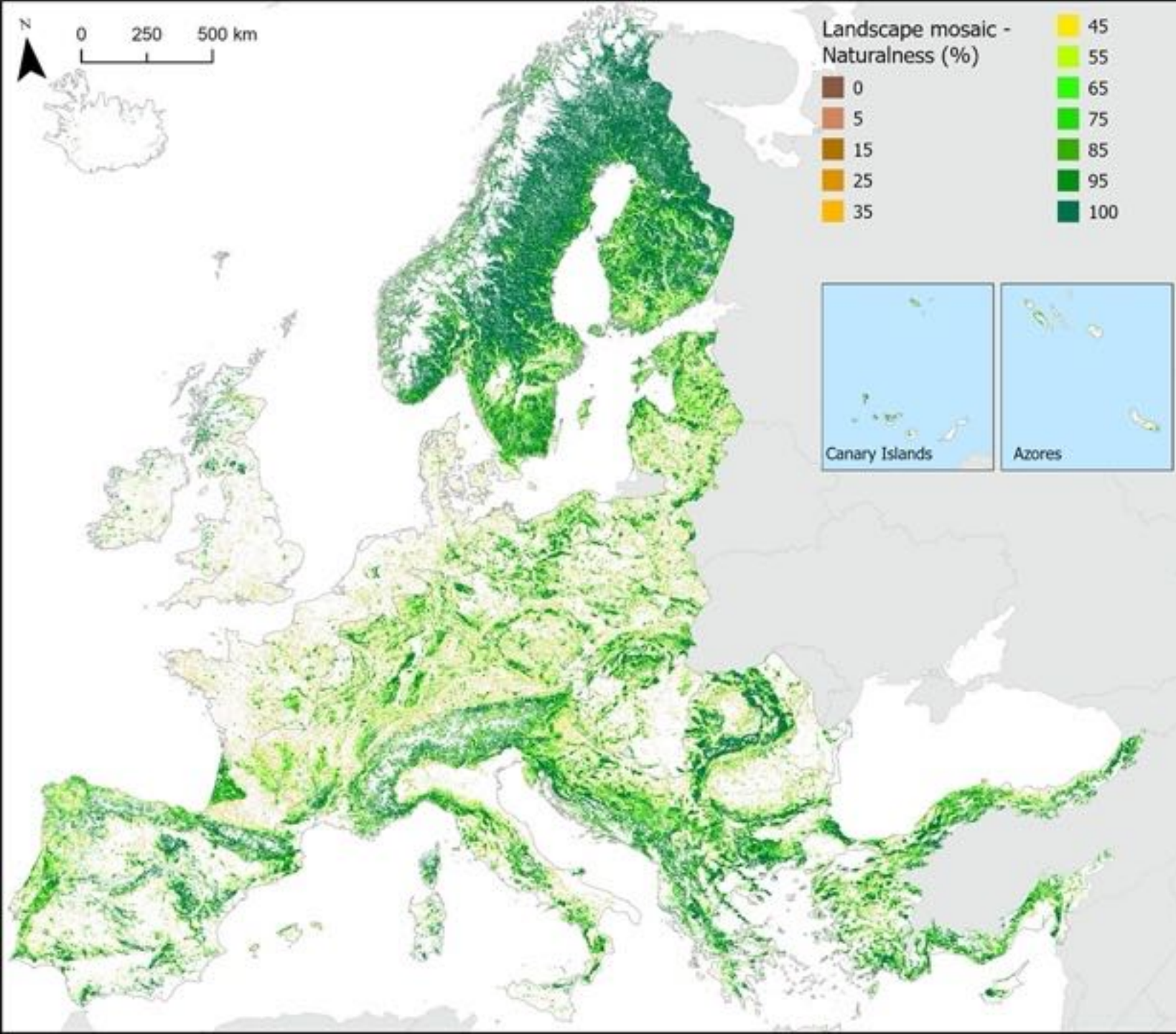- Species richness of threatened forest birds

- Tree cover density

- Forest productivity - Normalized difference vegetation index (NDVI)

- Forest connectivity

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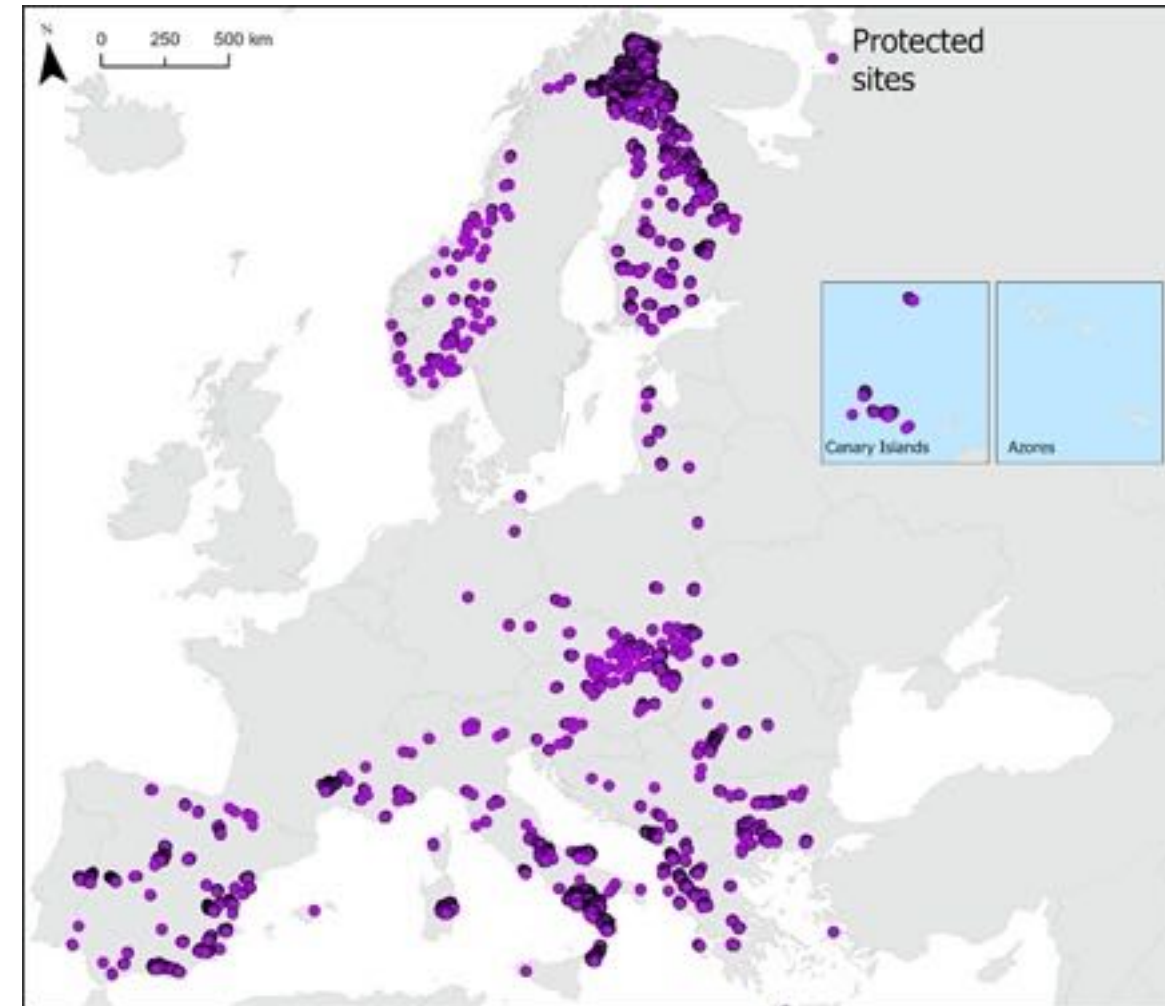
Forest condition variables

- Water content - Normalized difference water index (NDWI)

- Soil organic carbon

- Species richness of threatened forest birds

- Tree cover density

- Forest productivity - Normalized difference vegetation index (NDVI)

- Forest connectivity

- Landscape naturalness
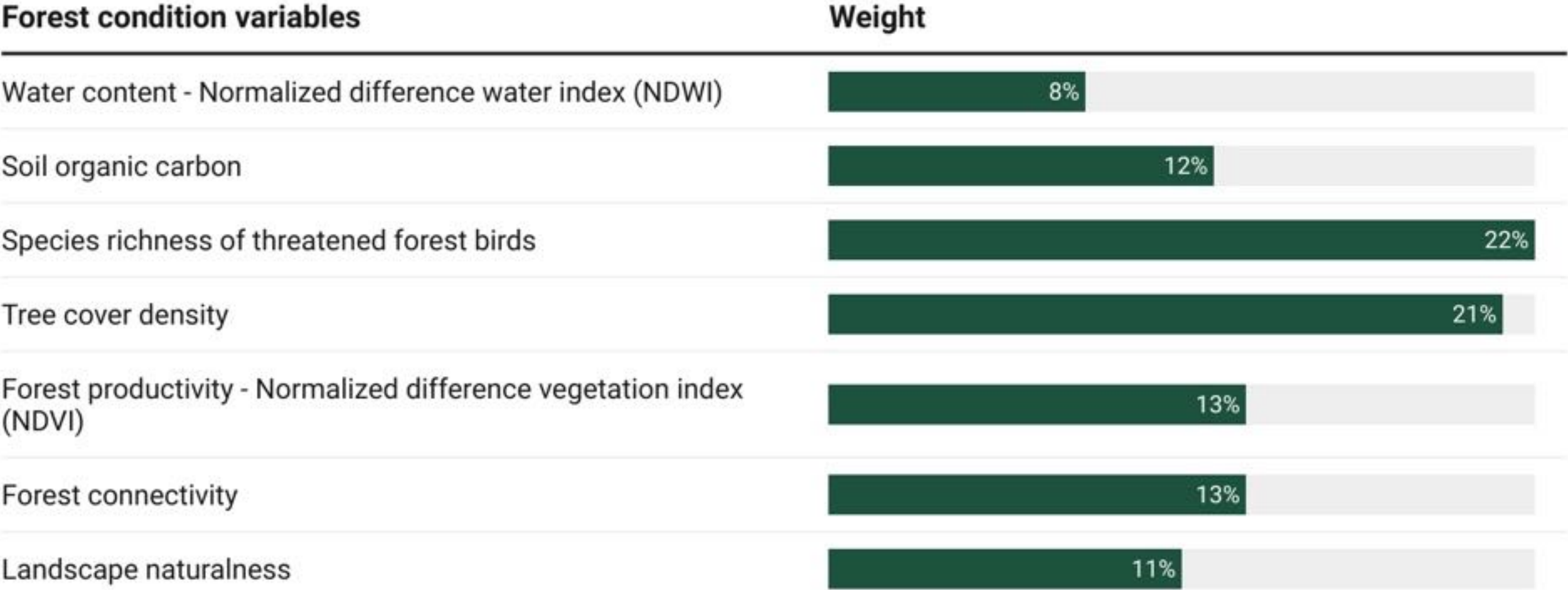
Forest reference conditions

Primary forests
2 million ha

Undisturbed protected sites
2.5 million ha

Weights assigned to the forest condition variables

Forest condition variables	Weight
Water content - Normalized difference water index (NDWI)	8%
Soil organic carbon	12%
Species richness of threatened forest birds	22%
Tree cover density	21%
Forest productivity - Normalized difference vegetation index (NDVI)	13%
Forest connectivity	13%
Landscape naturalness	11%

Forest condition account

Declining condition in 1/3 of the forest area
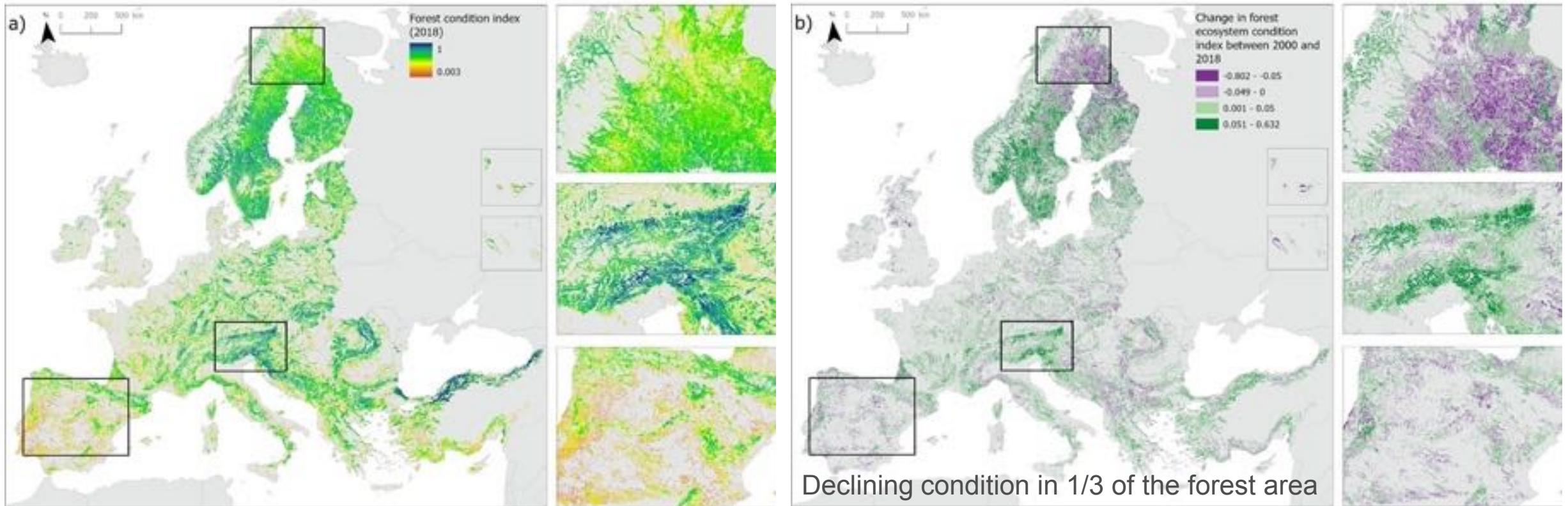
Variable		NDWI	SOC	Birds richness	Tree cover	NDVI	Connectivity	Landscape naturalness
Variable values (observed)	Year 2000	0.004	0.09	3.56	49.60	0.53	63.58	77.97
	Year 2018	0.008	0.15	3.76	52.93	0.57	64.01	78.44
Reference levels	Lower level	-0.28	0	0.29	0	-0.02	2.50	7.50
	Upper level	0.17	0.63	6.85	96.20	0.72	99.66	100
Indicator values (rescaled)	Year 2000	0.62	0.20	0.48	0.51	0.74	0.63	0.76
	Year 2018	0.63	0.22	0.48	0.55	0.80	0.63	0.77

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Conclusions

- Earth observation data essential for developing a forest account

- Methodology can be globally applied

- Dead wood, tree species richness, defoliation, tree growth, age structure, … might be more suitable variables but no mapped time series is available

- Correspondence with condition reporting for protected forest habitats in the EU

- Scientific debate on the reference condition

Thank you