Ecosystem Extent and Condition accounts in Spain

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Outline

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I. Spatial units and extent accounts

a. Spanish national Ecosystem Types classification used for ecosystem extend accounts
b. Main testing results for cross walking with IUCN and/or WES
c. Identify and discuss the main bottlenecks.

II. Condition accounts

a. Methodology based on the 3 stages: (1) reporting variables, (2) reference levels, (3) aggregation
b. Example on Forest condition accounts in Spain
c. Main gaps and needs to improve ecosystem condition

Spanish ecosystem types classification

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In Spain we are using LULUCF (Land Use, Land Use Change and Forestry) a multisource dataset for ecosystem accounting. LULUCF provide a high spatial resolution (25 meters per pixel) information for a significant time period (1970-2015).

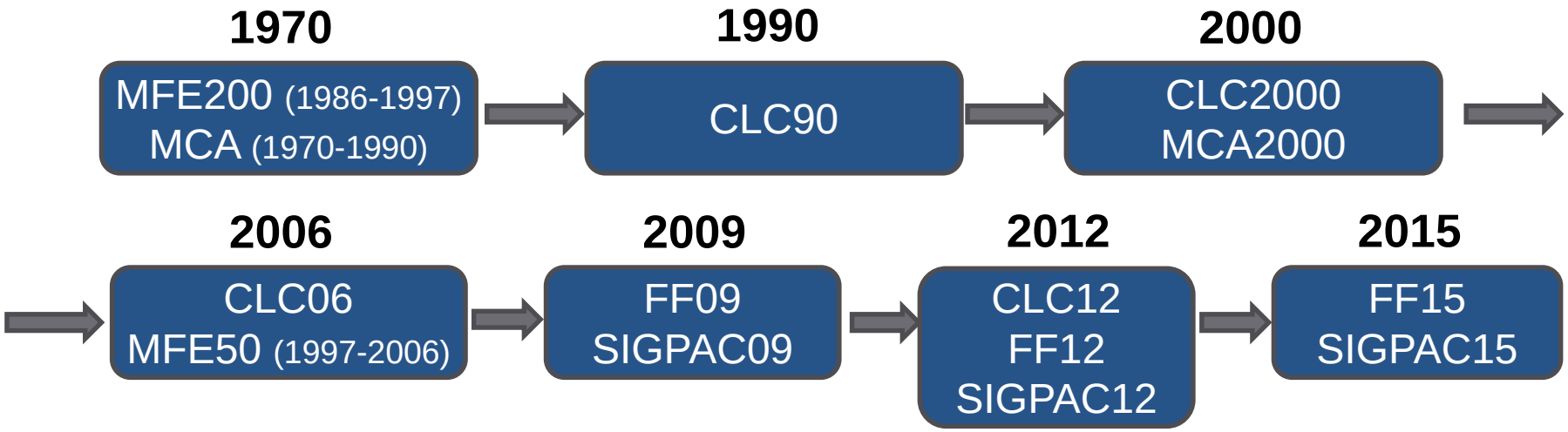

Fig.1. Spanish LULUCF including the principal data source for each time period. **Source:** Spanish Ministry for the Ecological Transition and the Demographic challenge

MFE200: Spanish Forest Map. 1:200.000

MCA: Crop and Harvest Map

CLC: Corine Land Cover

MFE50. Spanish Forest Map. 1:50.000

FF: Update of changes in MFE50

SIGPAC: Geographic Information System of Agricultural Plots

Spanish ecosystem types classification

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LULUCF (level 2) divided the territory in 16 categories as ecosystem types. MAES (level 1) typology distinguishes 12 main ecosystem types, which is a European reference classification with cross linkages to the habitat types listed in Annex I of the Habitats Directive.

LULUCF_level_1	id_1	MAES_level_1	LULUCF_level_2	id_2
Forest land	100	Forest and woodland	Broadleaved	110
			Coniferous	120
			Mixed	130
			Other Forests	100
Grassland	200	Grassland	Woodland	210
		Heathland and shrub	Shrubland	220
		Grassland	Perennial	230
			Other Grassland	200
Other Land	400	Sparsely vegetated land	Other Land	400
Wetlands	500	Inlands wetlands	Wetlands and Peatlands	500
		Rivers and lakes	Inland	510
		Marine inlets	Seaside	520
Cropland	700	Cropland	Perennial woody crops	710
			Annual crops	720
			Other Crops	700
Settlements	800	Urban	Settlements	800

Table I. Crosswalks between LULUCF and MAES ecosystem classification

Ecosystem Extend Accounts

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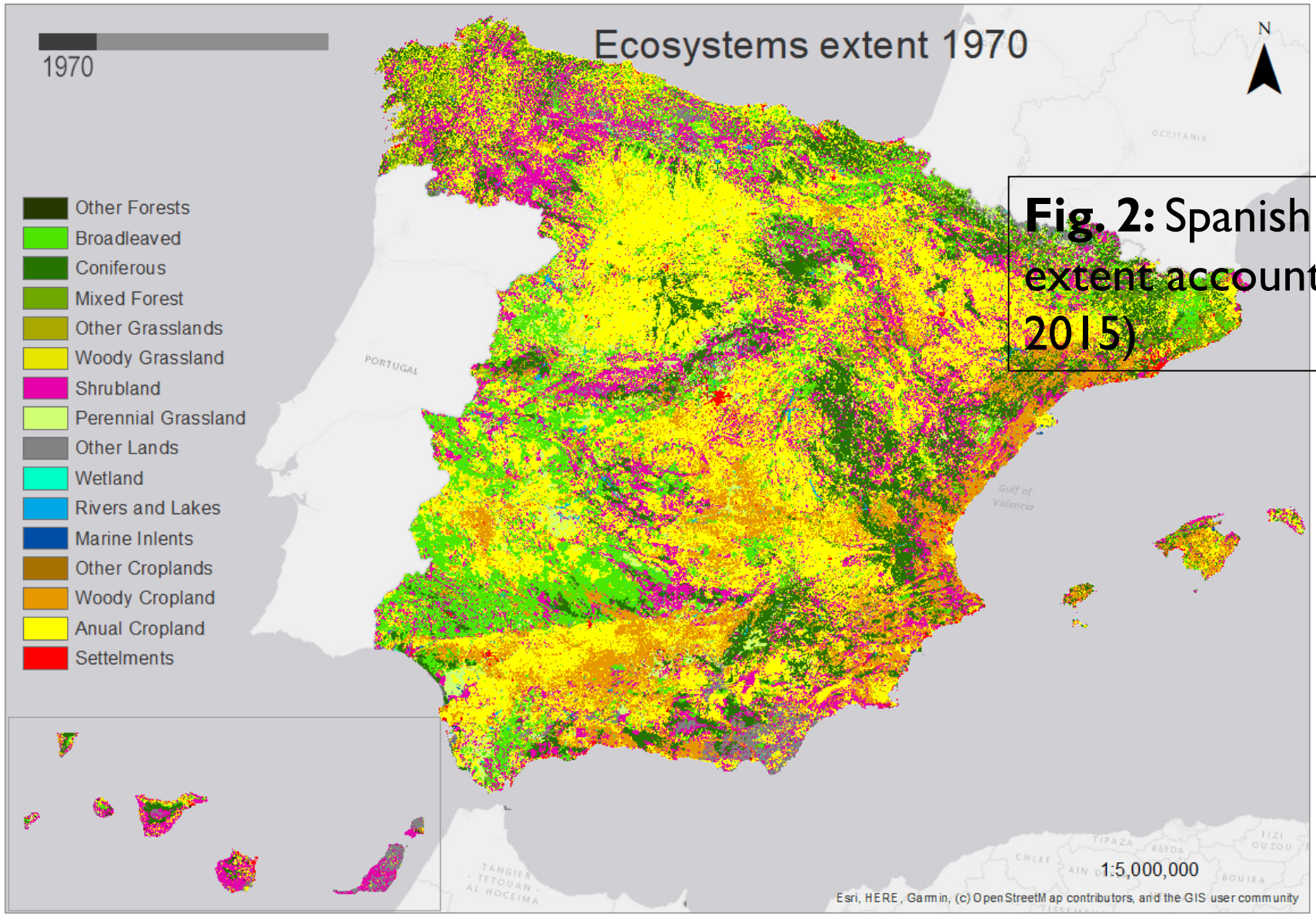

Fig. 2: Spanish ecosystem extent account (1970-2015)

Testing results for cross walking LULUCF with IUCN

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Major type	map unit #	List of national or regional units		Functional group	T2.1 Boreal and montane needle-leaved forest and woodland	T2.2 Temperate deciduous forests and shrublands	T4.4 Temperate wooded savannas	T4.5 Temperate grasslands	T7.1 Croplands	T7.2 Sown pastures and old fields	T7.3 Plantations	T7.4 Urban and infrastructure	Tally check	max	#candidate EFGs
Forest and woodland	110	Broadleaved				1							1	1	1
Forest and woodland	120	Coniferous			1								1	1	1
Forest and woodland	130	Mixed			0.5	0.5							1	0.5	2
Forest and woodland	100	Other Forests									1		1	1	1
Grassland	210	Grassland Woodland					1						1	1	1
Grassland	220	Shrubland											0	0	0
Grassland	230	Grassland Perennial						1					1	1	1
Grassland	200	Other Grassland								1			1	1	1
Other Land	400	Other Land											1	0.2	5
Wetlands and Peatlands	500/51	Wetlands and Peatlands											1	0.2	5
Wetlands and Peatlands	521/52	Water Inland											1	0.125	8
Wetlands and Peatlands	522/52	Water Seaside											1	0.195	6
Cropland	710	Perennial woody crops							1				1	1	1
Cropland	720	Annual crops							1				1	1	1
Cropland	700	Other Crops							1				1	1	1
Settlements	800	Settlements										1	1	1	1

Table 2. Results of the cross walking between LULUCF and IUCN ecosystem types classification

Testing results for cross walking LULUCF with IUCN

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Some bottlenecks

1. LULUCF classification do not include all temperature regimen (e.g. tropical, subtropical…) that in IUCN its crucial for natural and seminatural forest / shrublands ecosystems.

2. The classification in Agroecosystems is more detailed in LULUCF than in IUCN. These classifications are very important divisions in the context of Spain (Mediterranean).

Testing results for cross walking with USGS-ESRI work ecosystem

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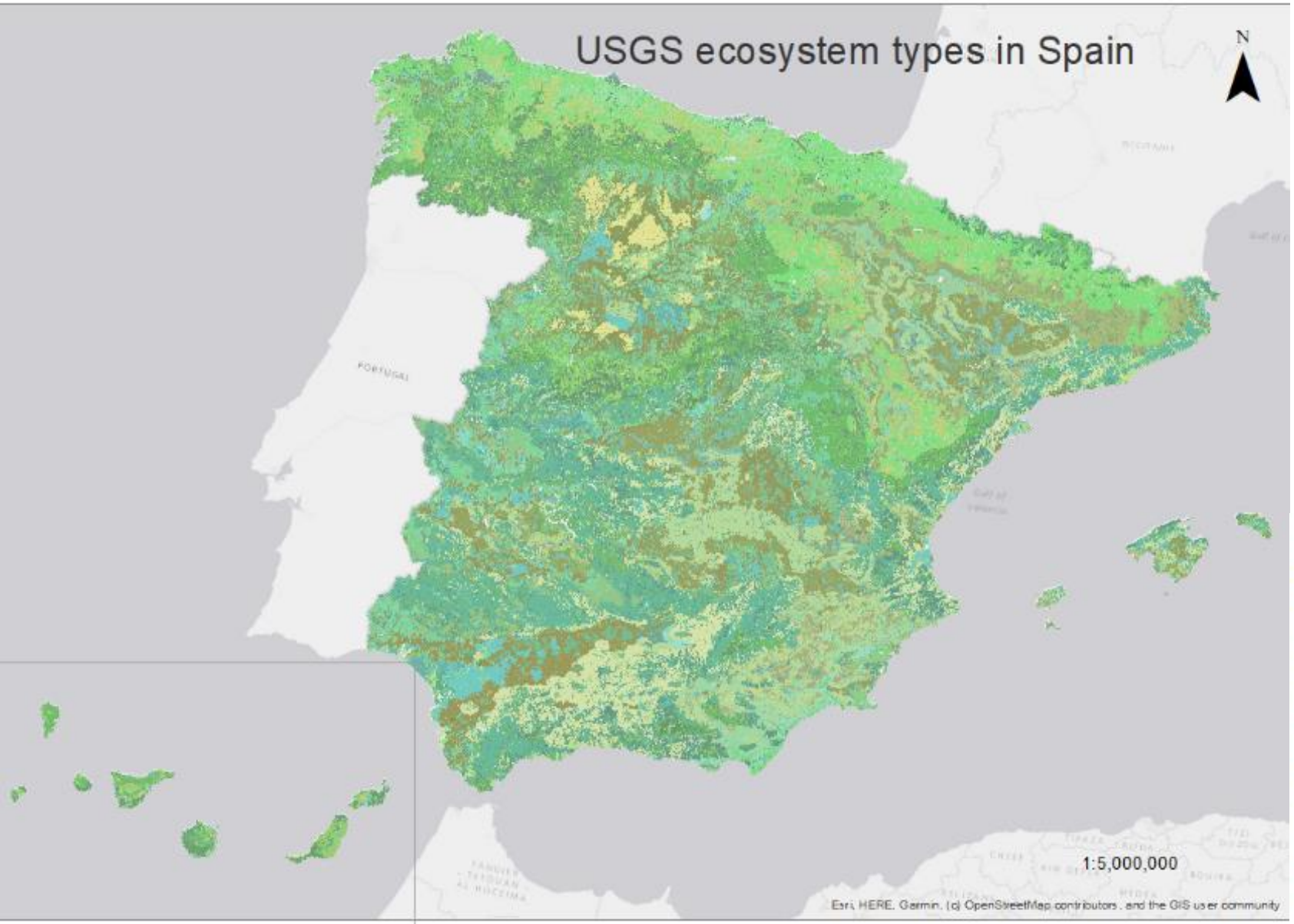
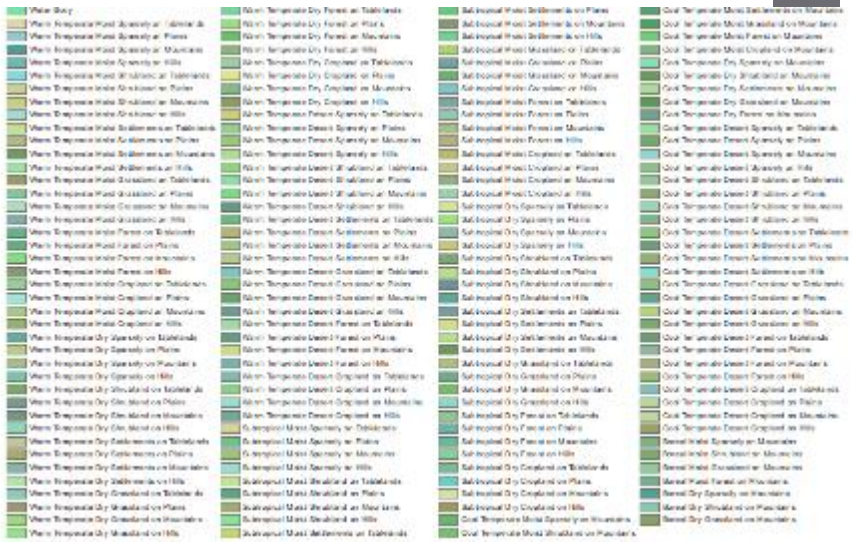


Fig. 3. Spanish map with the 190 ecosystems types identified using the USGS-ESRI word ecosystem



Testing results for cross walking with USGS-ESRI work ecosystem

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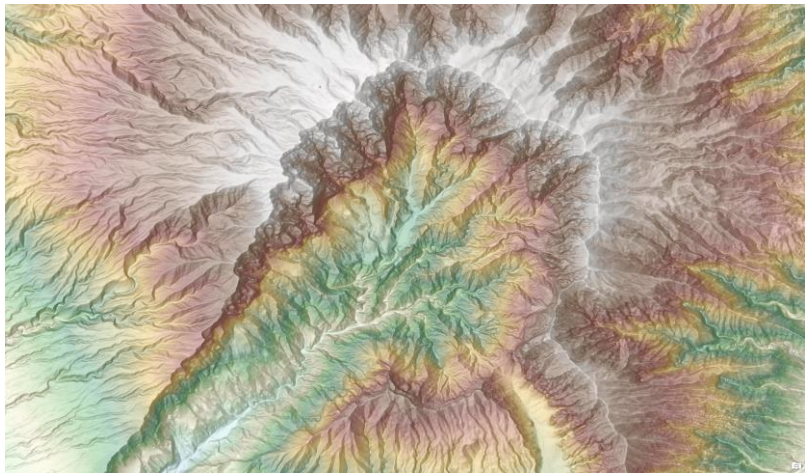
Some bottlenecks

1. We can improve the suitability of this classification by including more local information as local landform classification based on a digital terrain model developed for Spanish Geographic Institute.



Source: Spain's high-resolution elevation in Esri World Elevation Services

2. We identify an important gap in water ecosystem as wetlands.

Condition account. Method

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1. Indicators

Selection of national indicator following the hierarchical classification SEEA EEA ecosystem condition typology (SECT).

1. NDVI
2. Canopy fraction
3. Age of the site
4. GPP
5. NPP
6. MSPA
7. Forest area density (FAD)
8. NDWI
9. SOC
10. SR. Birds
11. SR. Reptiles
12. SR. Mammals
13. SR. Amphibious
14. SR. Vulnerable Vascular plants

2. Reference

To ensure the consistency for different variables describing the same ET.

We used the reference based on sites with minimum disturbance follow two criteria:

- We use the forest include in protected areas classify for UICN as level I, II, III or IV level of protected categories.
- We only include the forests which not have cover change since 1970

3. Aggregation

Evaluate the distance between the indicators in the reference areas with the all of the forest by class and region through Euclidean distance weighted.

Then we have made a four categories condition index by ecosystem group and region from unfavorable to favorable condition.

Forest Condition Accounts
Stage 0. Ecosystem typology

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Based on LULUCF forests categories (**3 types: broadleaved, coniferous, mixed**) we use a national classification of forests to create a more detailed forest categories (**48 forest types**) to assess condition. We use the next categories:

Table 3. Main categories to define forest ecosystem types to assess condition accounts in Spain

LULUCF	NATIONAL INVENTORY	BIOGEOGRAFICAL REGIONS
Broadleaved	Evergreen	Alpine
Coniferous	Deciduous	Atlantic
Mixed	Natural	Mediterrenean
	No natural	Macaronesia

Fig. 3. Map of biogeographical regions in Spain. Source Ministry of Ecological Transition and Demographic Challenge

Forest Condition Accounts
Stage 0. Ecosystem typology

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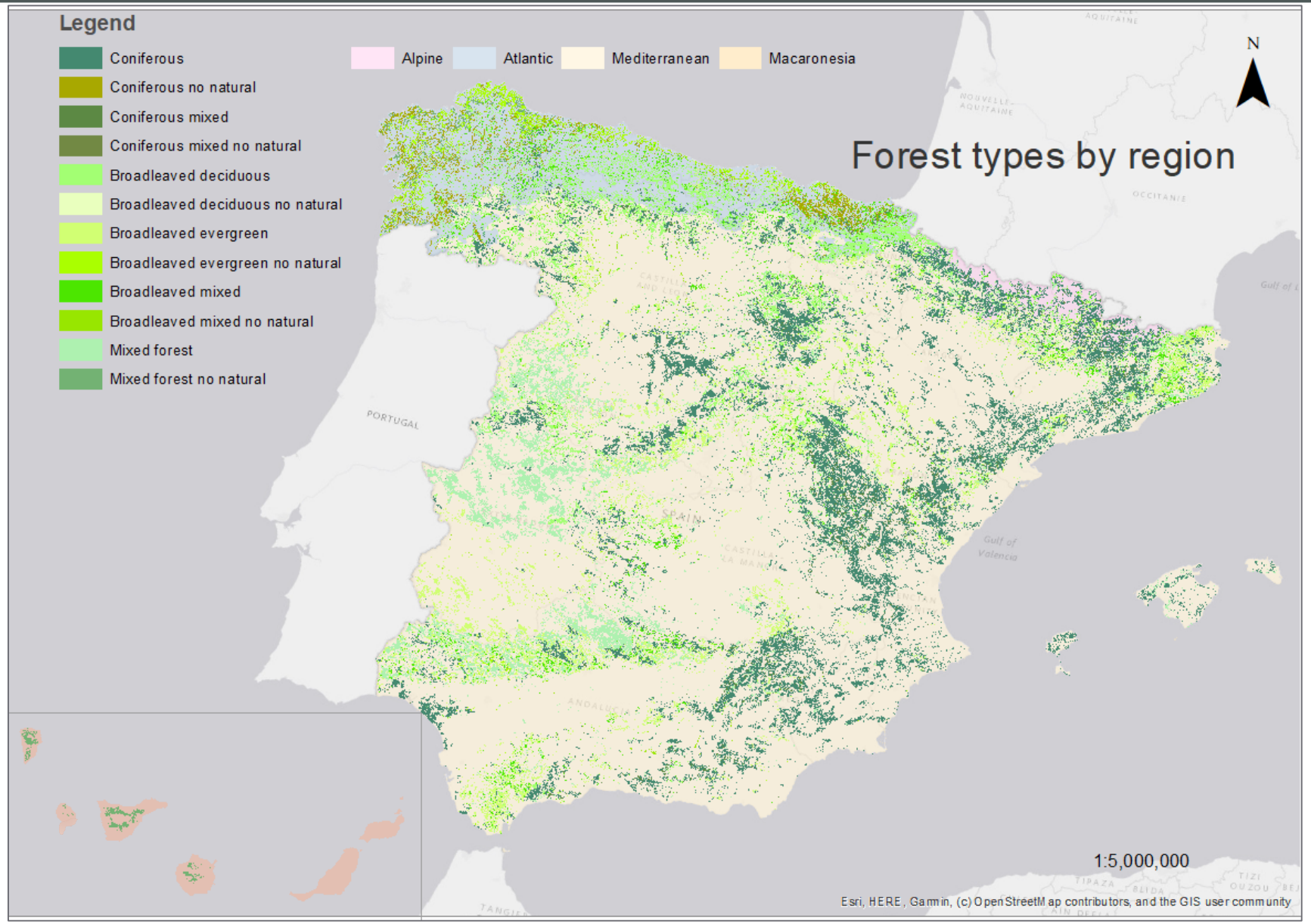

Fig. 4. Map of Spanish forest ecosystem types to assess condition accounts

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Forest Condition Accounts
Stage 1 Reporting variables

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ECT groups	ECT classes	Weight	Indicator	Source	Resolution (m)
Abiotic ecosystem characteristics	Physical state	0.5	NDWI	Landsat	30
	Chemical state	0.5	SOC	JRC	1000
Biotic ecosystem characteristics	Compositional state	0.3	SR. Birds	Ministry	10000
		0.15	SR. Reptiles	Ministry	10000
		0.3	SR. Mammals	Ministry	10000
		0.15	SR. Anfiv.	Ministry	10000
		0.1	SR. Vulnerable Vascular plants	Ministry	10000
	Structural state	0.2	NDVI	Landsat	30
		0.2	Tree canopy	Landsat/Modis	30/500
	Functional state	0.2	Age of site	LULUCF	25
		0.2	GPP	Modis	500
		0.2	NPP	Modis	500
Landscape characteristics	Landscape characteristics	0.5	Morphological Spatial Pattern Analysis	LULUCF	35
		0.5	Forest Area Density	LULUCF	50

Table 4. 14 national variables selected to assess forest condition and their characteristics following the hierarchical classification SEEA EEA ecosystem condition typology (SECT).

Forest Condition Accounts
Stage II Reference level

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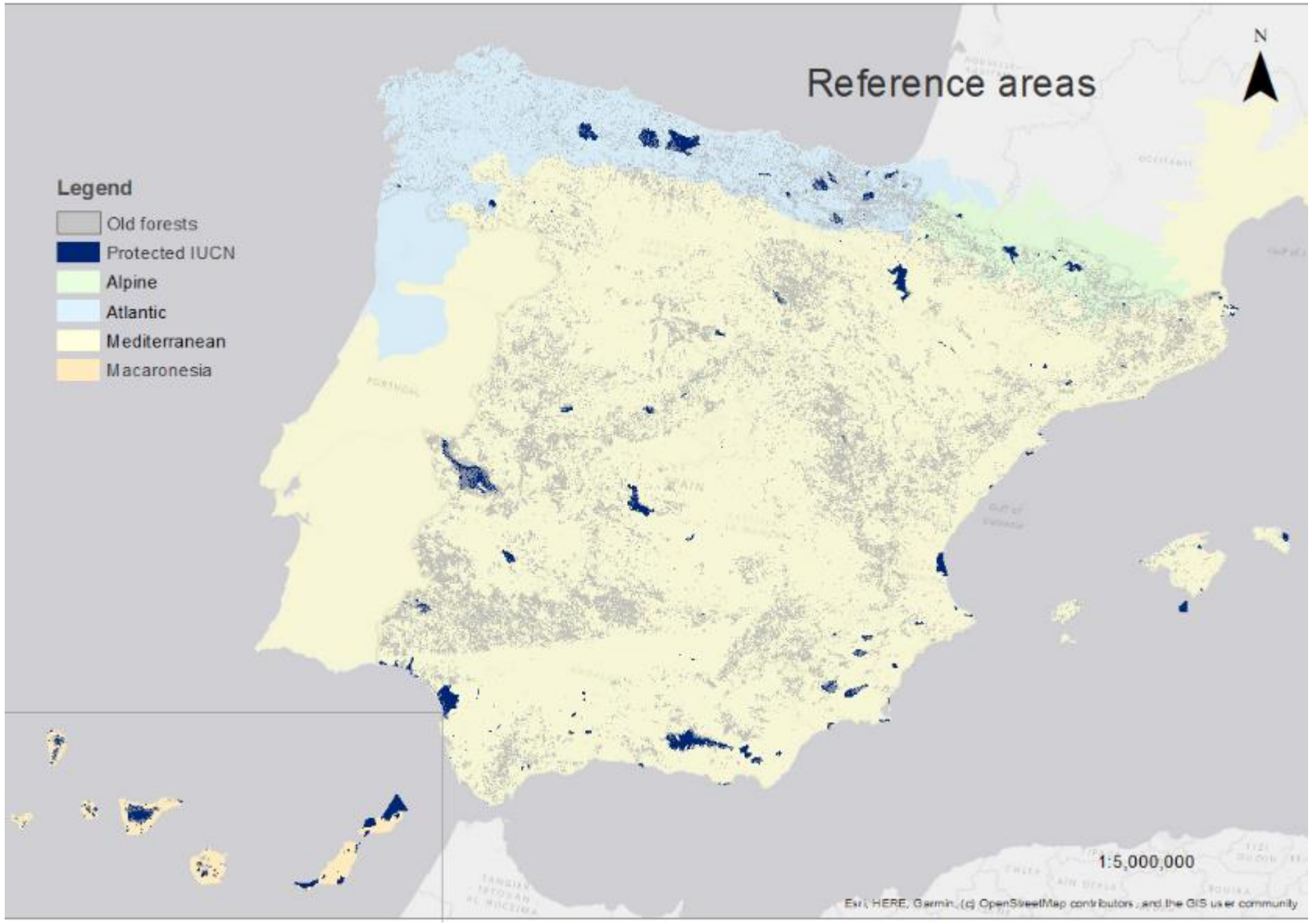

We used the reference based on the criteria of minimum disturbance:

- Protected areas classify by IUCN as level I, II, III or IV.
- Forests with not net change since 1970.

Fig. 5. Reference condition areas to assess forest condition accounts in Spain

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Forest Condition Accounts
Stage 3 Aggregation

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General idea: Evaluate the distance between the normalized variables in the reference areas with the all of the forest by class and region.

Calculation: Euclidean distance weighted (Equation 1). To aggregation proposes we used the average reference values of the reference areas by group and region.

$$Edw = \sqrt{\sum_{i}^{j} w_i (x_i - y_i)^2} \quad \text{Equation I}$$

Creation of and ecosystem condition index. Results of the calculation were divided in four categorical quartiles (a. Unfavorable: less to 25%, b. Regular: 25-50%, c. Average: 50-75%; and d. Favorable: higher than 75%).

Forest Condition Accounts

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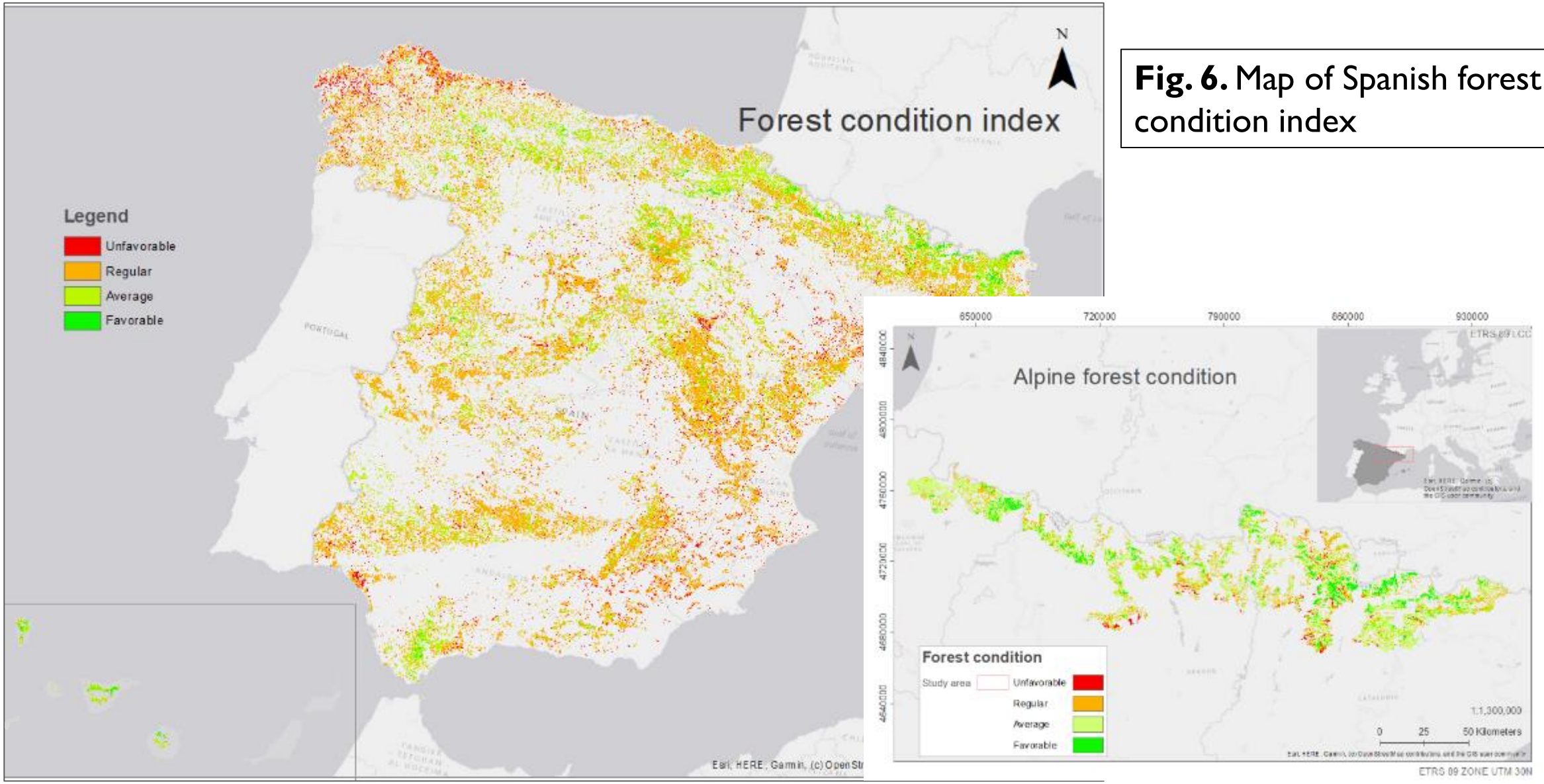

Fig. 6. Map of Spanish forest condition index

Conclusion

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- Exits enough sources of data available to develop extent and condition accounts at national level.
- The appropriateness to link existing land use data and ecosystem classifications need further analysis.
- The proposed international ecosystem classification (IUCN) need further development to be applicable at different levels (national, regional, local).
- The proposed methodologies to assess condition accounts are still under development and need to be validated. For example, a standard list of indicators and reference levels
- Aggregation methods are need it, but we still need more research to scientificaly relates condition accounts index with ecosystem state and trend.

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Thank you!

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