

Explorando el estado de condición de los bosques a través del SEEA-EA:

Dos casos de estudio a escala nacional (España) y Europea

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Policy context

In March 2021, the United Nations Statistical Commission (UNSC) adopted the System of Environmental-Economic Accounting—Ecosystem Accounting (SEEA EA), more specifically its chapters 1-7 as an *international statistical standard* and chapters 8-11 as *internationally recognized statistical principles and recommendations for valuation of ecosystem services and assets*. This new statistical framework will enable countries to measure their natural capital and understand the contributions of nature to our prosperity and the importance of protecting it. It will mark a major step forward towards incorporating sustainable development in economic planning and policy decision-making and could have a significant impact on efforts to address critical environmental emergencies, including climate change and biodiversity loss.



Policy context

EU biodiversity strategy 2030: “develop an EU-wide methodology to map, assess and achieve good condition of ecosystems so they can deliver benefits”

Nature restoration law

EU legislation

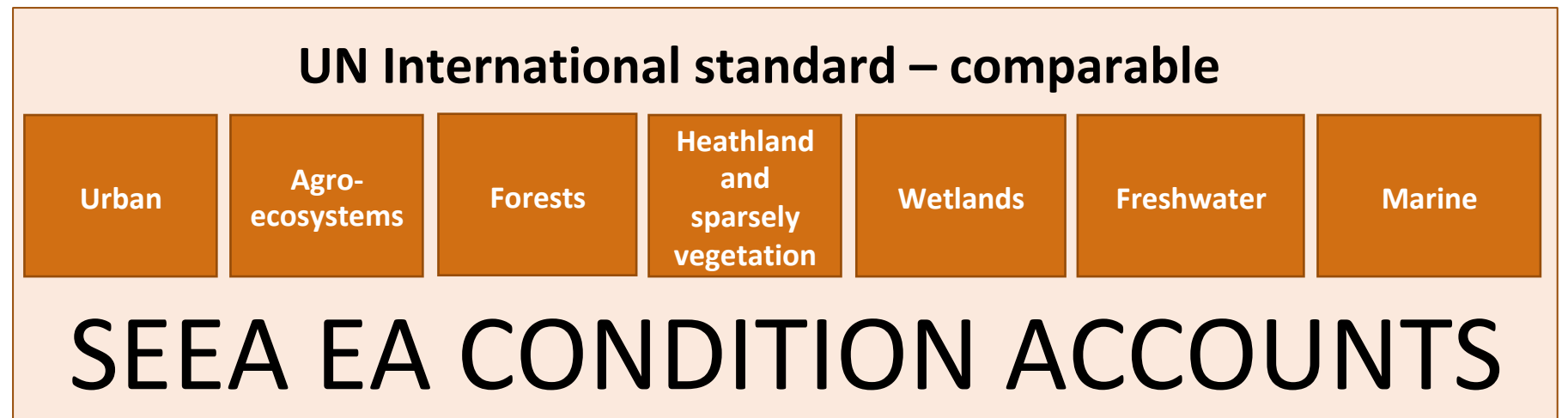
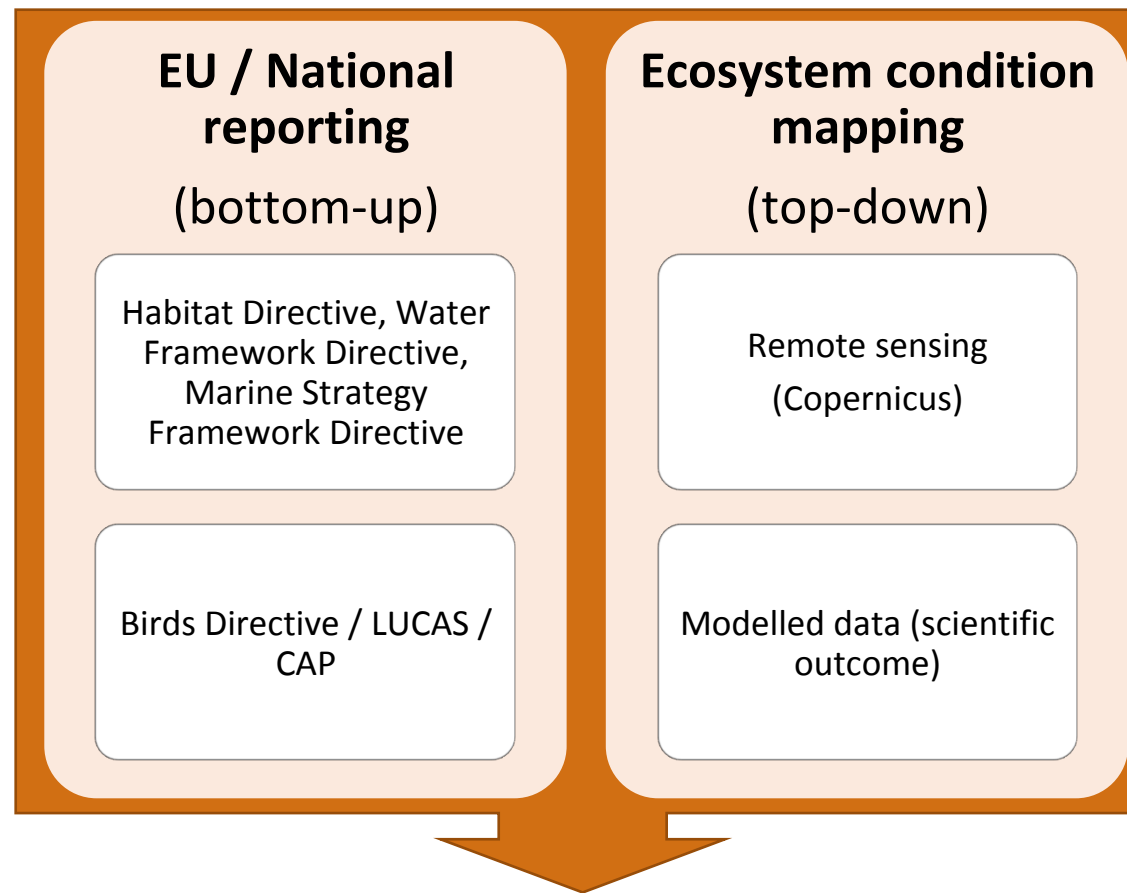
- Habitats Directive: ‘**structure and functions**’
- Water Framework Directive: **Chemical and ecological status** of water bodies
- Marine Strategy Framework Directive: **Environmental status** of marine ecosystems



SEEA-EA

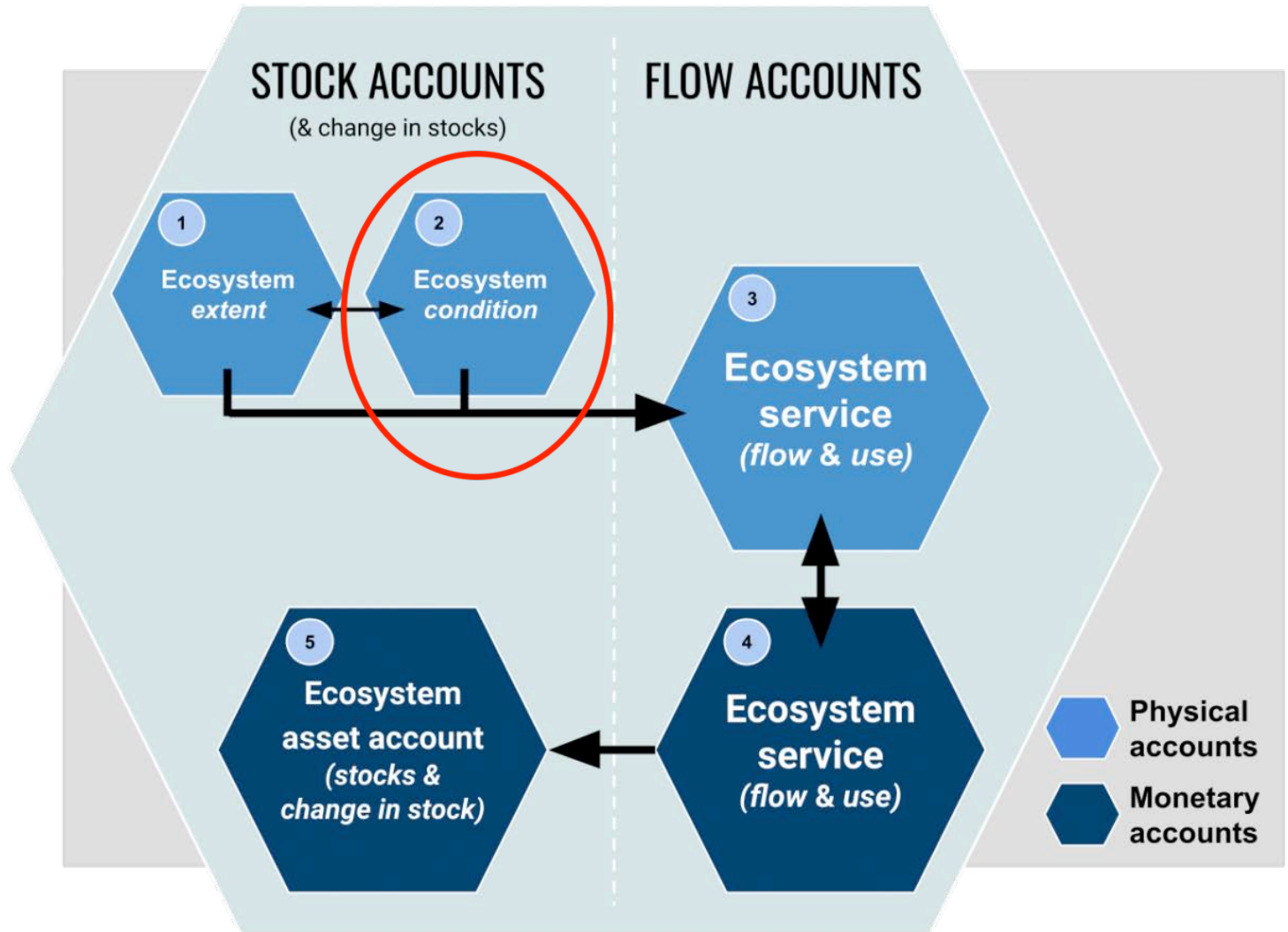
Amendment of **Regulation on environmental accounting for ecosystem accounts** (Eurostat): **ecosystem condition accounts**

Towards a common EU methodology for ecosystem condition



SEEA EA condition accounts

Based on the SEEA-EA guidelines: ecosystem condition is the quality of an ecosystem measured in terms of its abiotic, biotic and landscape characteristics. Condition is assessed with respect to an ecosystem's composition, structure and function which, in turn, underpin the ecosystem integrity of the ecosystem, and support its capacity to supply ecosystem services.



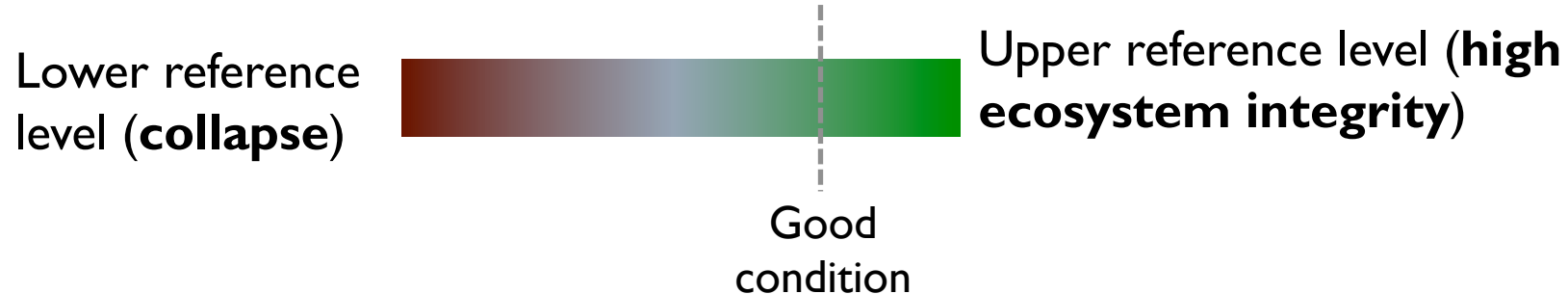
SEEA Ecosystem accounts and how they relate to each other

SEEA EA condition accounts

A step wise approach

1) Selection of 'variables' using the **ecosystem condition typology** (ECT): physical, chemical, compositional, structural, functional and land- and seascape

2) Definition of reference levels:

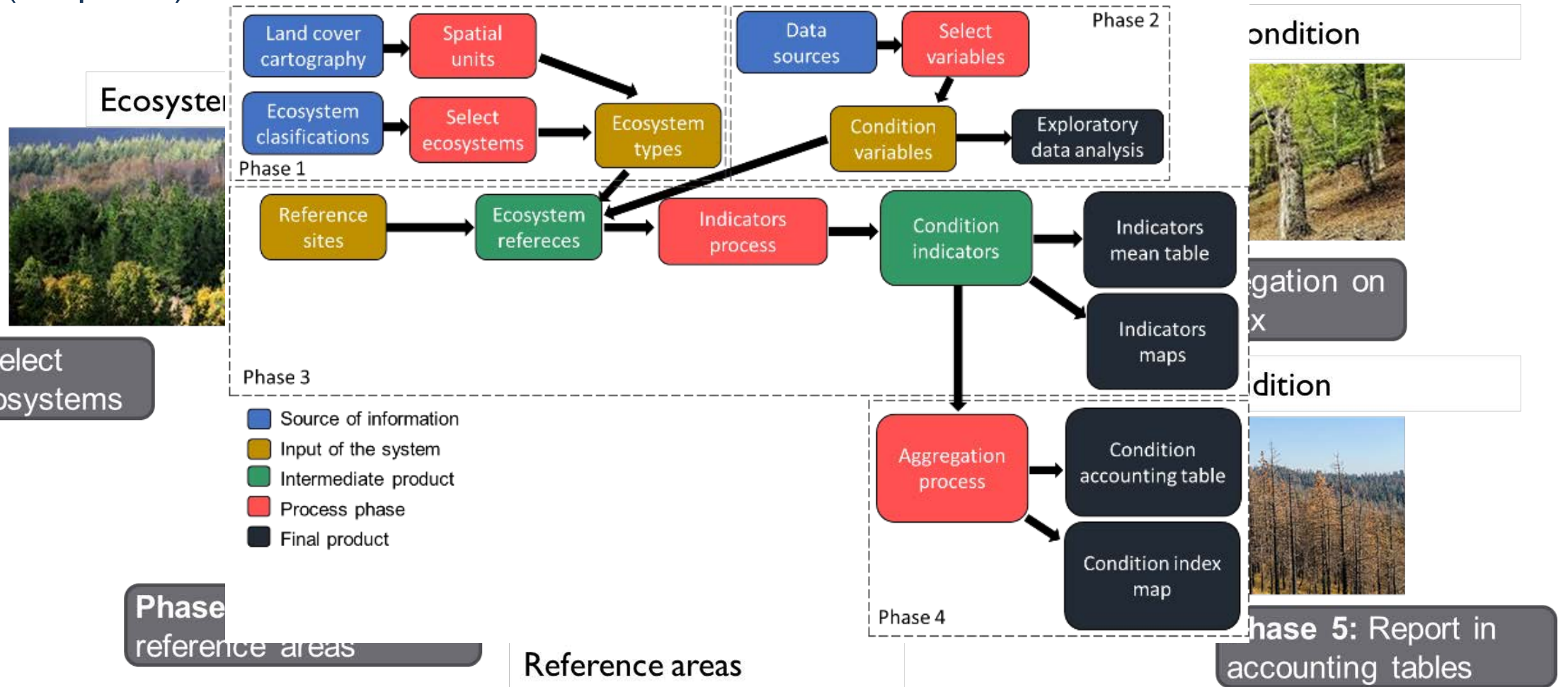


3) Rescaling between 0 and 1 (comparable condition indicators)

4) Aggregation into one single condition index (optional)

SEEA EA condition accounts

CONDITIONS ACCOUNTS: A methodology has been developed following the principles outlined in SEEA-EA (chapter 5) for **forest ecosystem**.



SEEA EA condition accounts

Stage 1: Ecosystem types

Classification of forest ecosystems based on land cover cartography, ecosystem classification and biogeographical regions.

- **Stage 2: Indicators selection**
- Selection criteria of indicators:
 - **1. Directionality or normativity** (the indicator has to be related in a straightforward manner to ecosystem condition; it has to be sensitive to human influence or pressures that decrease condition);
 - **2. Spatially and temporal explicit data** in order to track changes
 - **3. For every ECT class have at least 1 indicator.**

Stage 3: Reference sites

Reference values based on areas of **an undisturbed or minimally disturbed condition:**

- Primary forest
- Forest areas included in protected areas classified in IUCN level I or II categories.
- Forests that have not undergone cover changes since 1970.

A reference value has been generated by indicator, and ecosystem type.

Stage 4: Aggregation

We have evaluated the **distance between the weighted indicators in the reference areas** with the rest of the forest areas.

Finally, we divide the **condition index into five categories**, from unfavorable to favorable.

Case studies

For the **Spanish Pilot** we are working in ecosystem accounting as part of MAIA H2020 EU project:

- We collaborate with the Ministry of Ecological Transition and Demographic Challenge and National Statistics Office to elaborate national ecosystem accounts .
- We finished ecosystem extent accounts for the period 1970 and 2015.
- We tested SEEA-EA methodology for forest condition accounts for period 2000-2015
- Currently, working on biophysical and economic ES accounts.

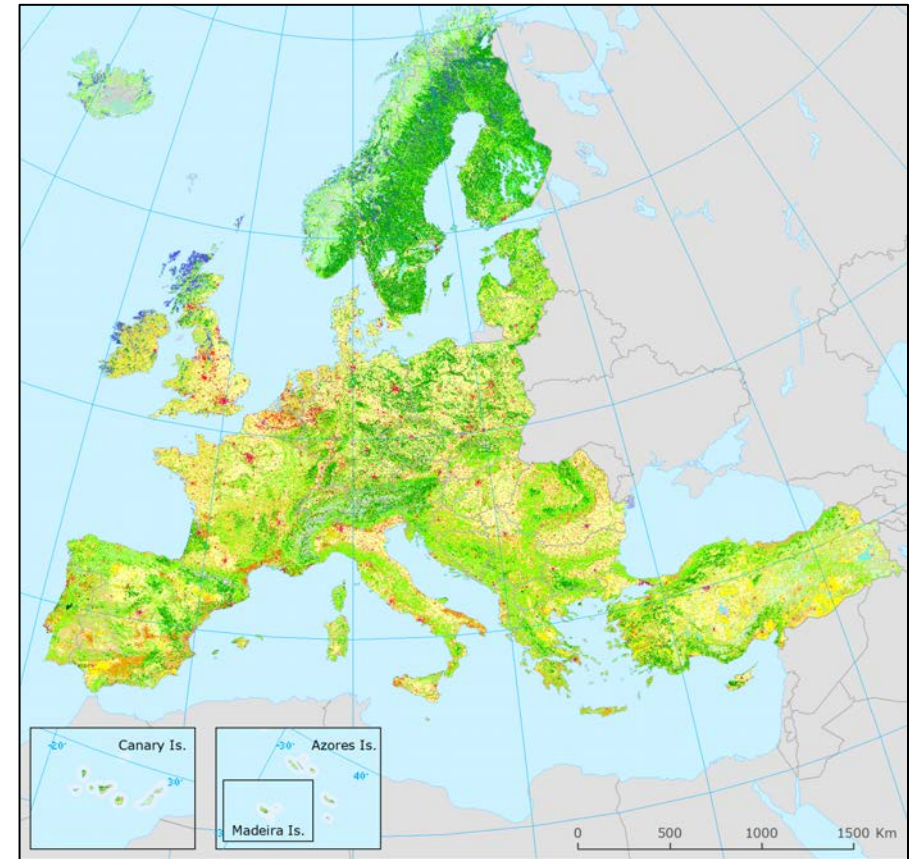
For the **European forest Pilot**, we are working together with the European Joint Research Center (JRC) in the project “**Mapping the condition of forests in the EU relative to a reference condition**”.

- The project follows the SEEA EA guidelines on ecosystem condition accounts.
- This project **describes an approach to upscale the Spanish approach to EU level.**

Stage I: Forest ecosystems classifications



For the Spanish pilot we used a combination of LULUCF database and the ecosystem classification developed for National Ecosystem Assessment (SNEA, 2014)
 6 types of forest ecosystem x 3 types of tree cover.
A total of 18 types of forest.



For Europe pilot we used the forest categories of Corine Land Cover database and the Biogeographical regions found in Europe
 11 Biogeographical regions x 4 types of tree cover.
A total of 44 types of forest.



Stage 2: Indicators Selections

Spanish pilot

Class	Indicator	Source
Physical state	NDWI	Landsat
	SOC	JRC /Eurostat
Chemical state	AOT40f	EEA
	Critical loads for eutrophication	EEA
	Critical loads for acidification	EEA
Compositional state	Species richness forest birds	Art. 12 D.Aves
	Species richness forest mammals	Art. 17 D.Habitat
	Species richness forest vascular plants	Art. 17 D.Habitat
Structural state	Tree cover	Modis
Functional state	NDVI	Landsat
	GPP	Modis
	NPP	Modis
Landscape characteristics	Morphological analysis of spatial patterns	Guidos
	Forest area density	Guidos
	Naturalness index	Guidos

In Spanish pilot we used **15 indicators** to measure the condition index

Europe pilot

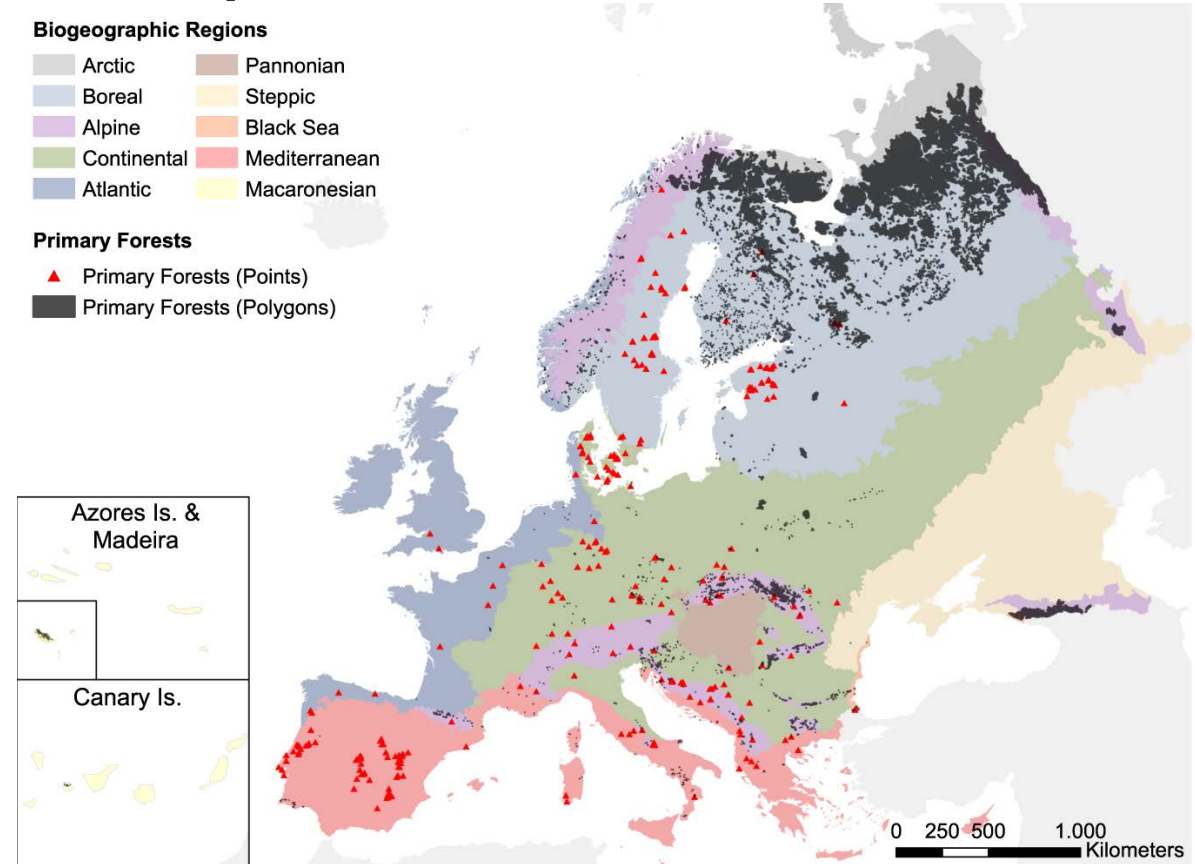
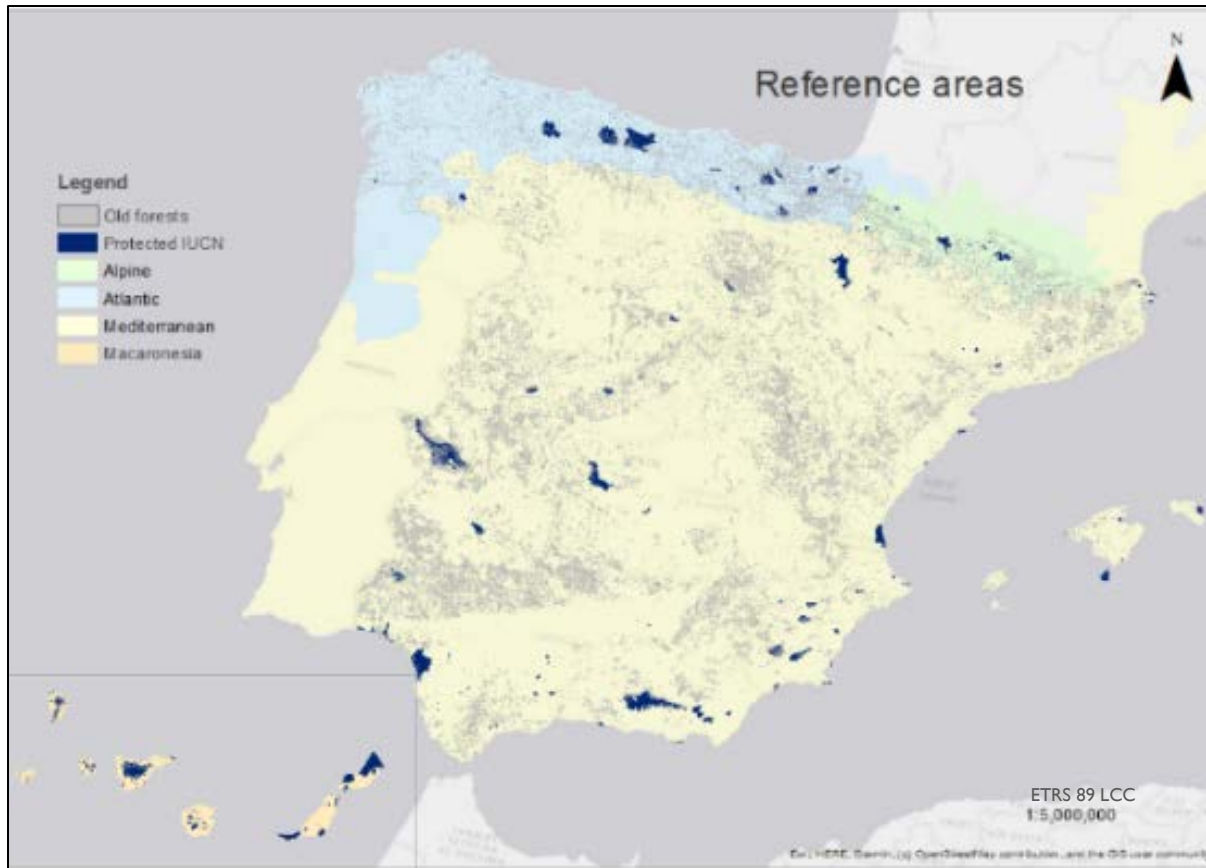
Class	Indicator	Source
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Chemical state	Critical loads for eutrophication	EEA
	Critical loads for acidification	EEA
Compositional state	Species richness forest birds	Art. 12 D.Aves
Structural state	Tree cover	Copernicus
Functional state	NDVI	Modis
Landscape characteristics	Forest area density	Guidos
	Landscape mosaic	Guidos

In Europe pilot we used **9 indicators** to measure the condition index



Stage 3: Reference Sites

We used the reference based on **undisturbed sites or minimally disturbed condition.**



Selection criteria for reference sites:

1. Protected areas classify under UICN level I, II. AND
2. Forests which not have cover change since 1970.

Selection criteria for reference sites:

1. Primary forests OR
2. Protected areas UICN level I, II OR
3. Reference sites of other similar biogeographical regions.

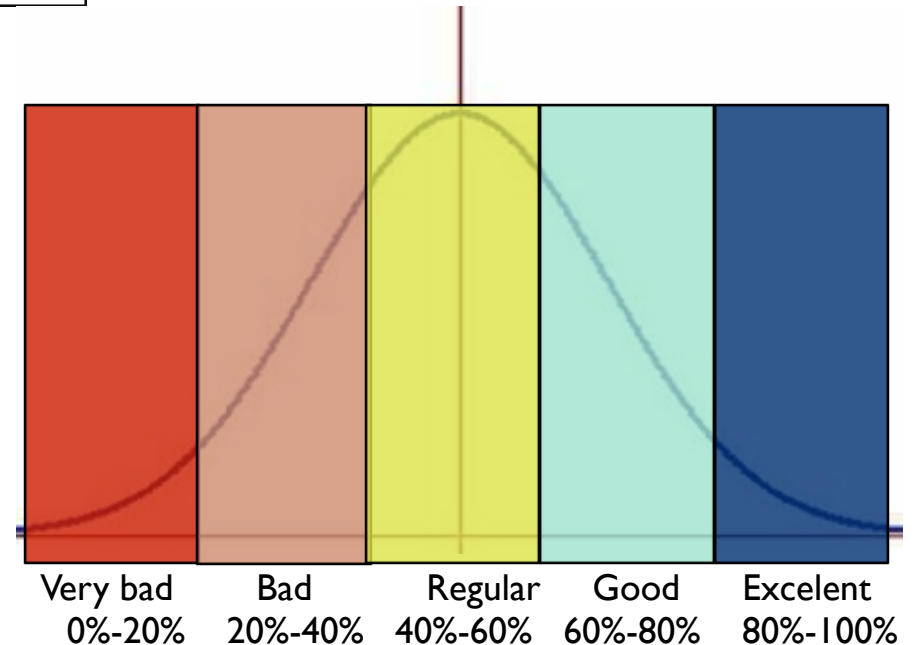
Stage 4: Aggregation

The aggregation is based on the evaluation of the distance from the reference areas with all forests types. The formula used is a variant of min-max feature:

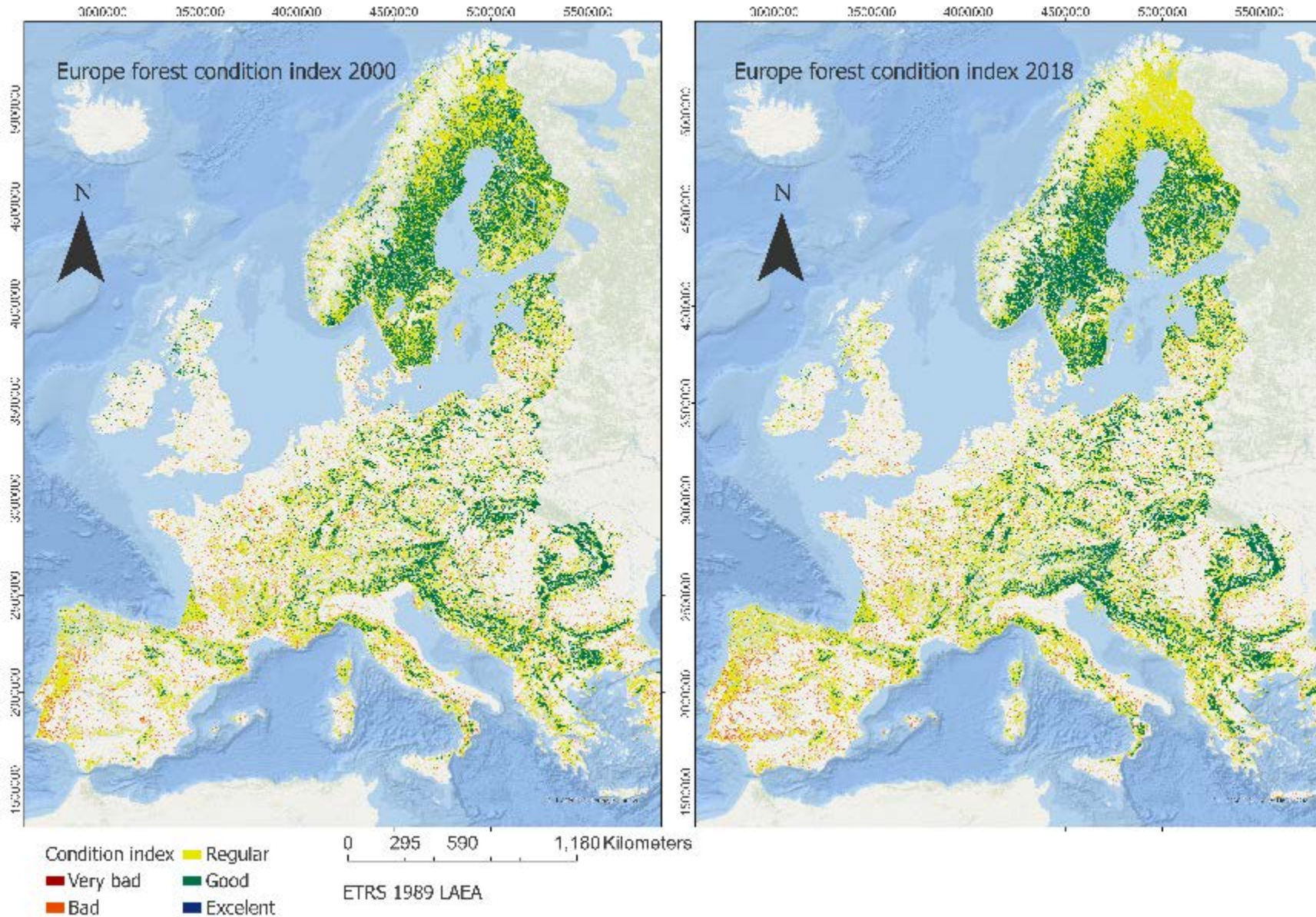
$$indice = \sum_1^i (w_i \frac{x - min.ref_i}{max.ref_i - min.ref_i})$$

Equation I

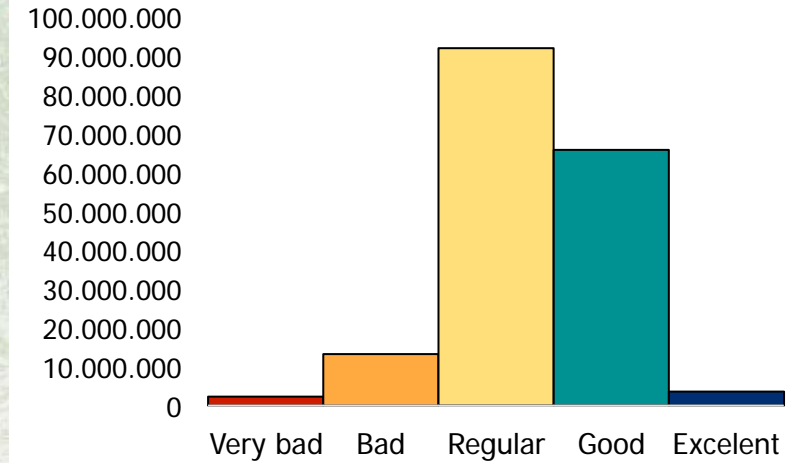
Then, we divided the index in five categories (less to 20%, 20-40%, 40-60%, 60-80% and high to 80%) to create a **categorical ecosystem condition index**.



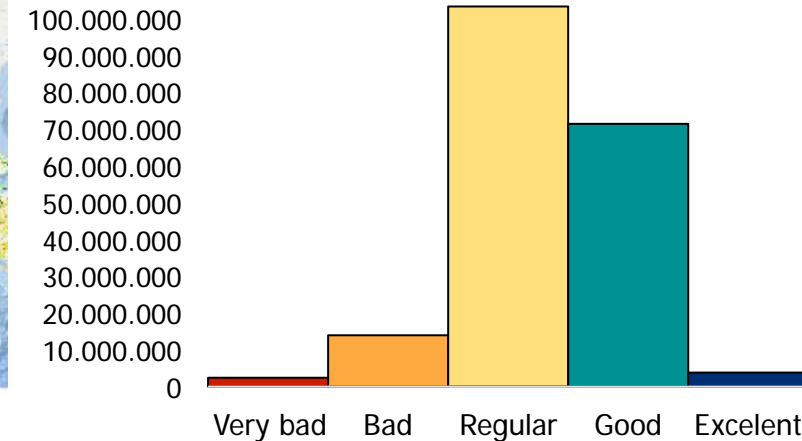
Stage 4: Aggregation



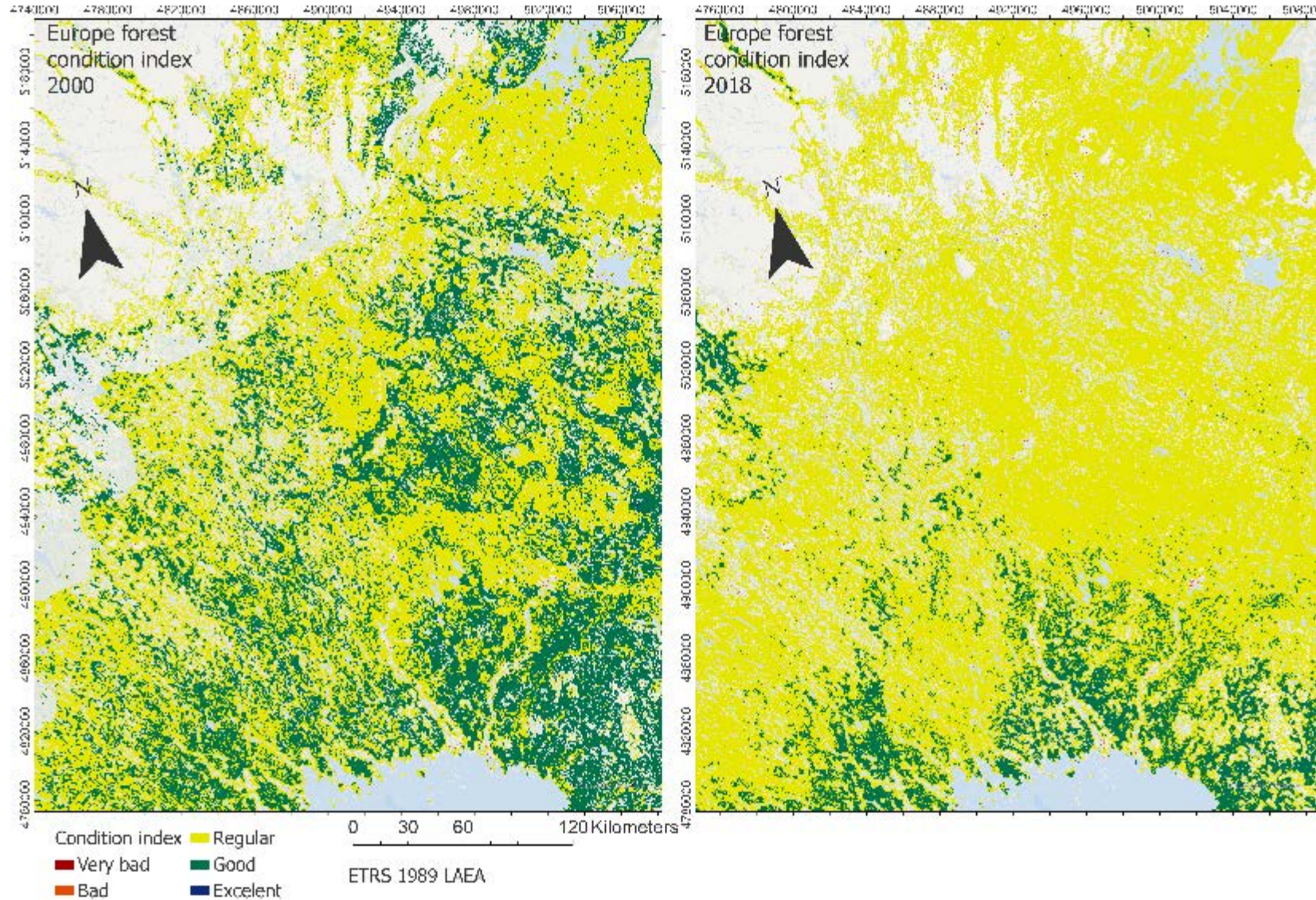
Europe forest condition index 2000



Europe forest condition index 2018

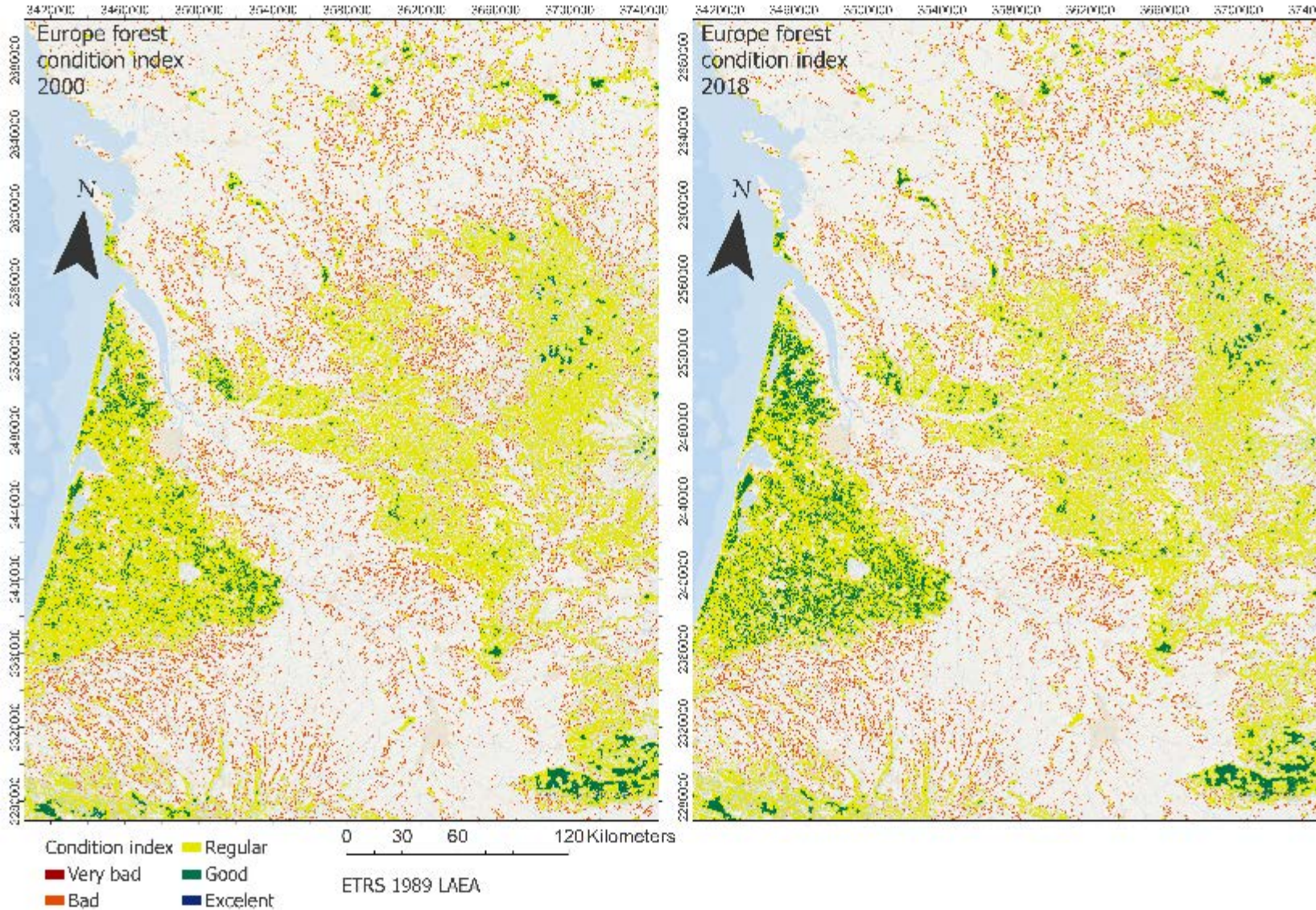


Stage 4: Aggregation



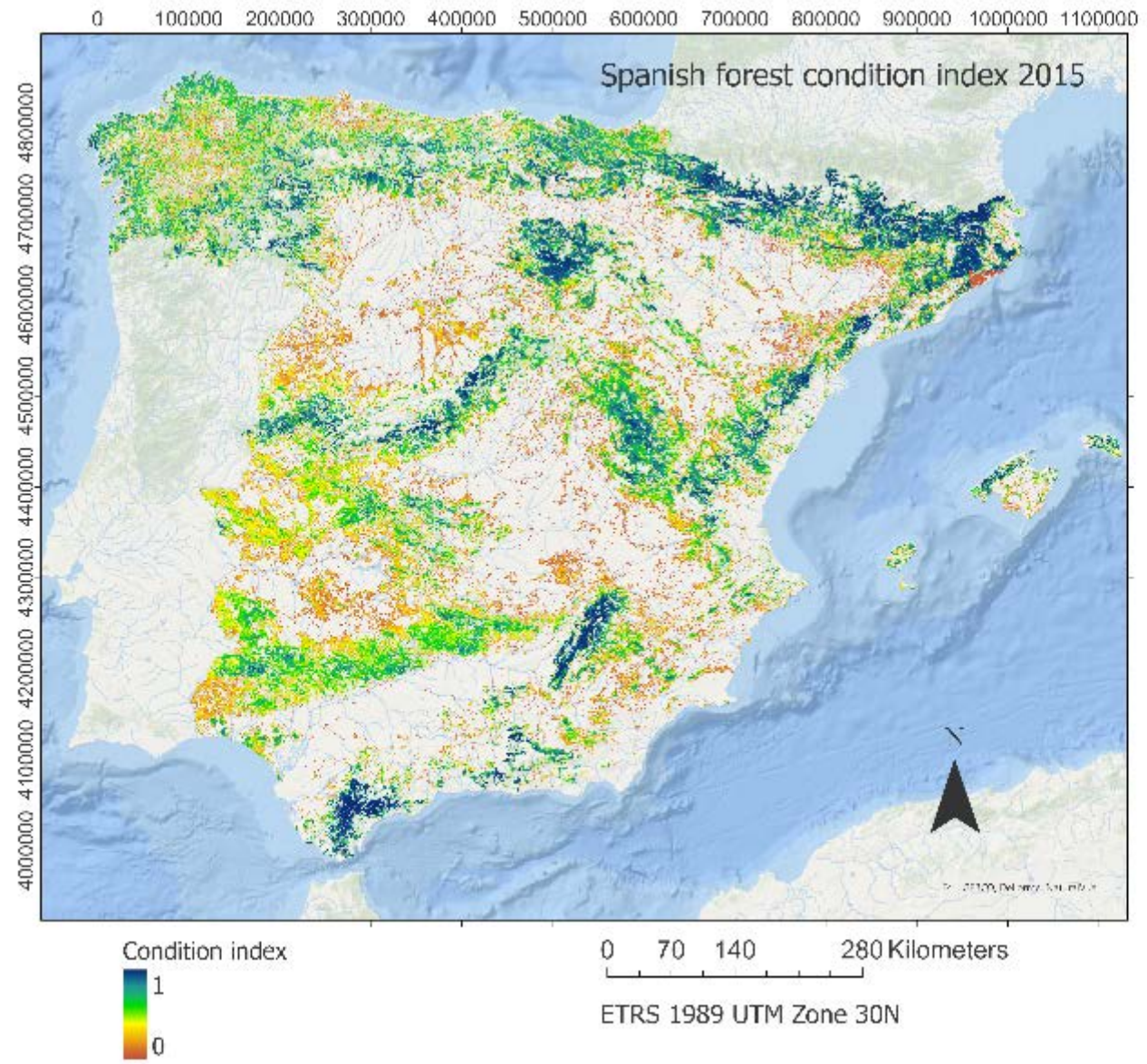
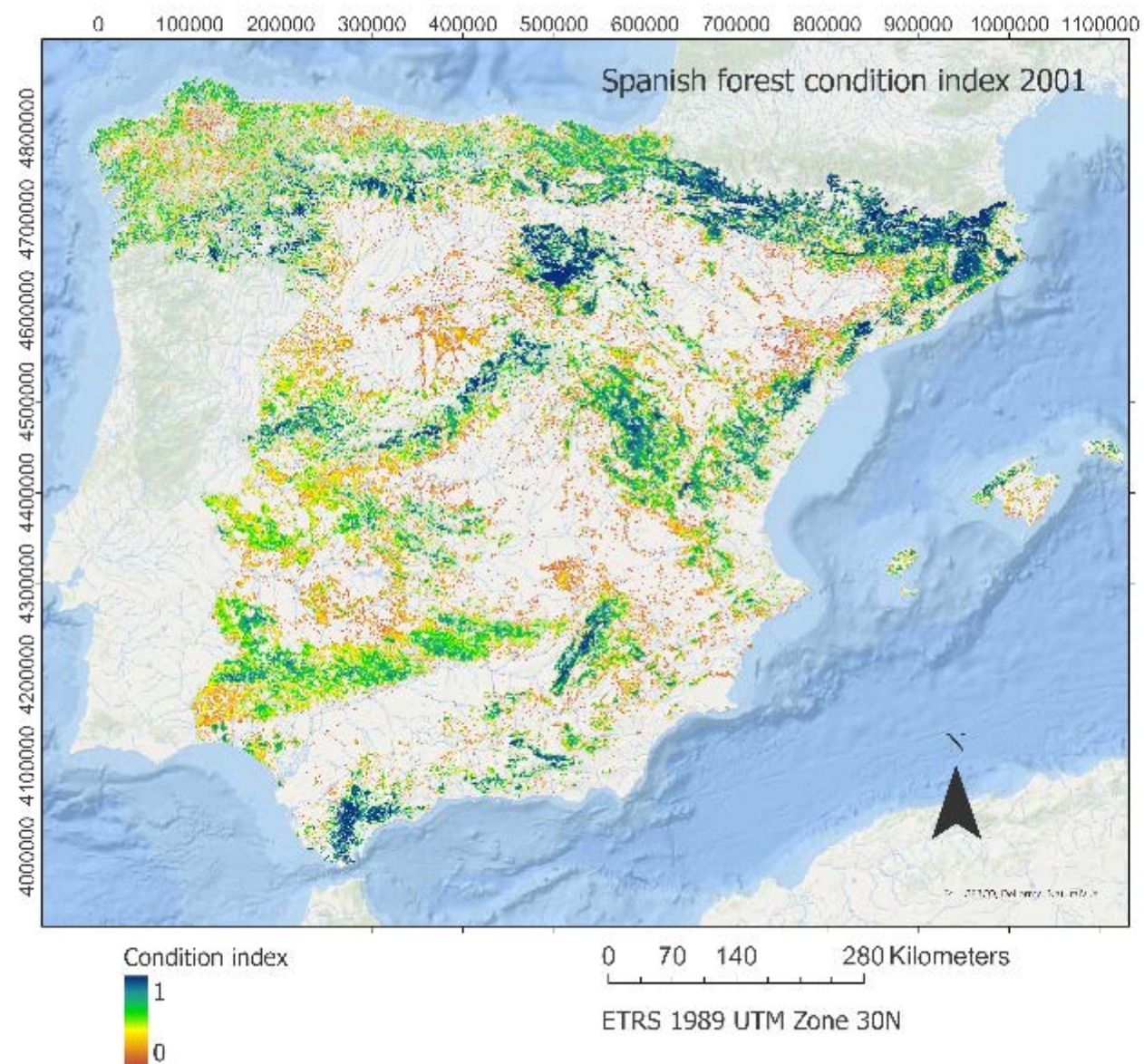
Example of negative trend in the condition index. Boreal forest.

Stage 4: Aggregation

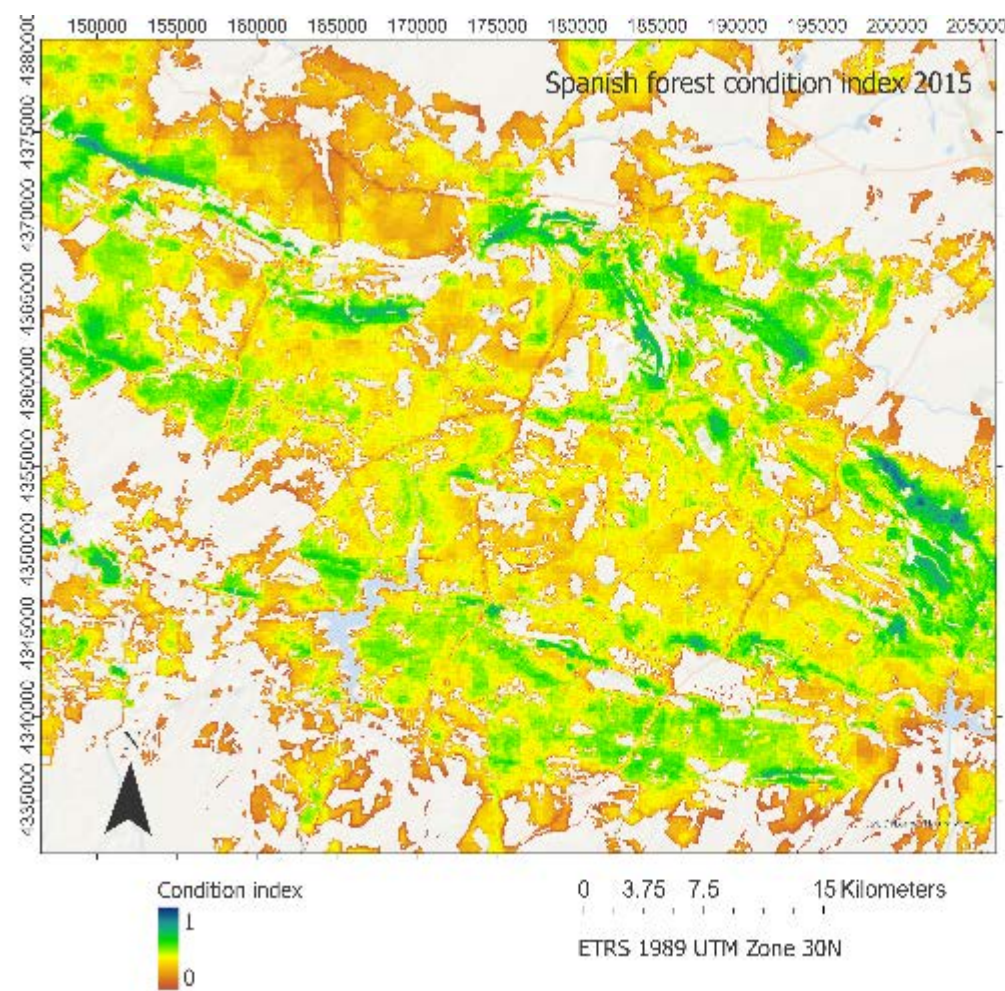
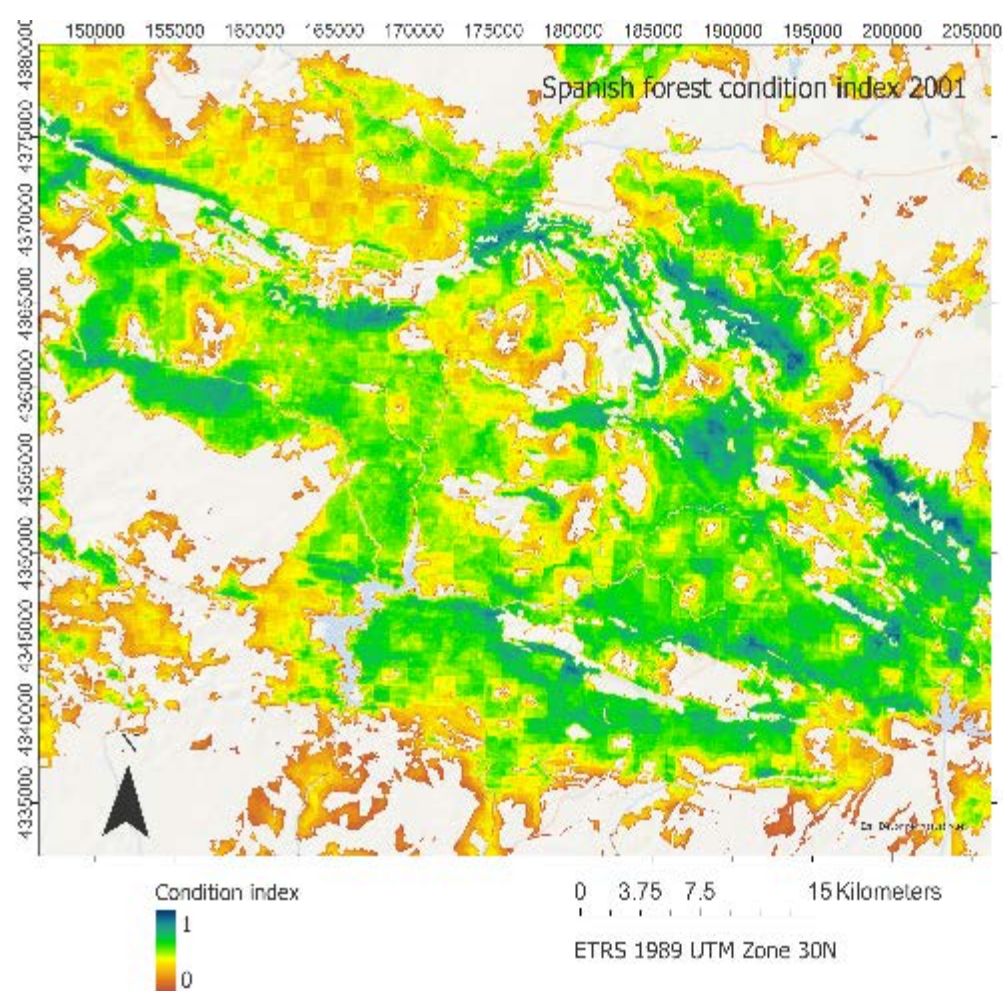


Example of positive trend in the condition index. Atlantic forest.

Stage 4: Aggregation

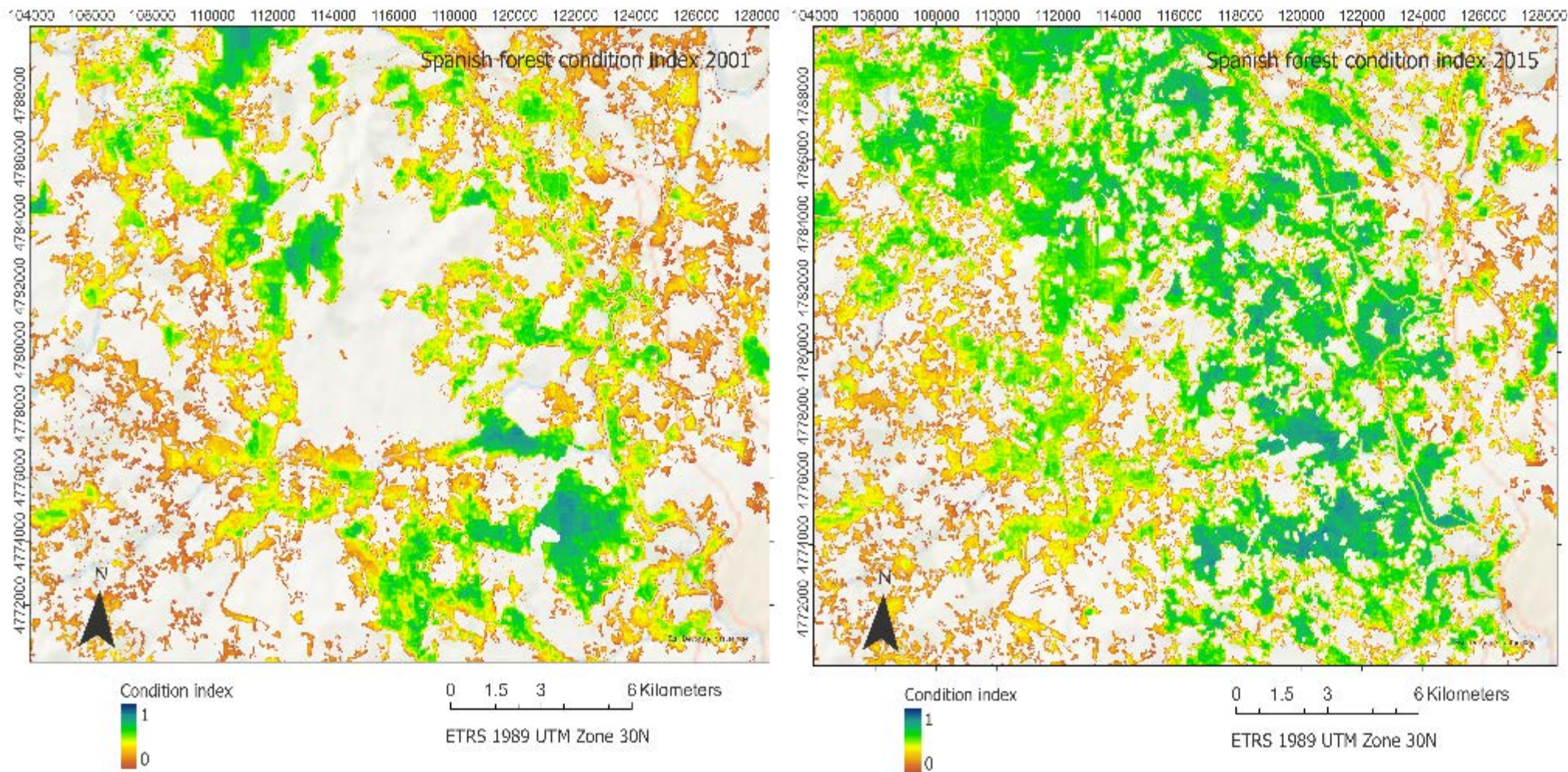


Stage 4: Aggregation



Example of negative trend in the condition index. Sclerophyllous Mediterranean forest

Stage 4: Aggregation



Example of positive trend in the condition index. Atlantic forest

Stage 4: Aggregation

Accounting table

Indicator	2001					2015					Change
	Value_mean	Ref_Max	Ref_Min	Weight	Value_rescale	Value_mean	Ref_Max	Ref_Min	Weight	Value_rescale	
ndwi	0.20	0.45	-0.15	0.06	0.04	0.25	0.45	-0.15	0.06	0.05	0.60%
soc	3.99	9.57	0	0.06	0.03	3.89	9.57	0.00	0.06	0.03	-0.09%
o3	47480.33	69503.61	26361.95	0.07	0.04	36581.01	69503.61	26361.95	0.07	0.02	-1.94%
acid	0.99	1	0.73	0.07	0.07	1.00	1.00	0.73	0.07	0.08	0.15%
eutro	0.81	0.96	0.29	0.07	0.06	0.79	0.96	0.29	0.07	0.06	-0.21%
birds	29.47	45.58	3.83	0.10	0.05	32.97	45.58	3.83	0.10	0.05	0.64%
flora	7.26	14.33	2.39	0.07	0.03	8.64	14.33	2.39	0.07	0.04	0.89%
tree	33.58	70.98	0.40	0.17	0.04	34.82	70.98	0.40	0.17	0.04	0.14%
ndvi	0.30	0.49	-0.09	0.06	0.05	0.34	0.49	-0.09	0.06	0.06	0.60%
gpp	233.91	380.40	0	0.06	0.05	260.33	380.40	0.00	0.06	0.05	0.53%
mspa	17.63	20	0	0.06	0.07	18.04	20.00	0.00	0.06	0.07	0.16%
fad	68.50	93.73	0	0.08	0.06	68.10	93.73	0.00	0.08	0.06	-0.03%
lm	3.18	4.00	0.47	0.06	0.06	3.71	4.00	0.47	0.06	0.07	1.14%
Total index											2.58%

Final remarks

- SEEA-EA methodology seem to be a **systematic and consistent approach** to organize biophysical information on forest ecosystem condition
- SEEA-EA methodology is capable of **integrating data from different data flows**.
- Applicable at **different spatial scales**
- **Further testing is needed:** integration and validation between EU and MS level of monitored data

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