



FIRE-RES

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Centro
Ecologia
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Temporal and spatial patterns of Extreme Wildfire Events (EWE) at the European landscape scale

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1. FIRE-RES and definition of extreme wildfire events (EWE)

FIRE-RES PROJECT - “Innovative technologies and socio-ecological-economic solutions for fire resilient territories in Europe” (H2020)

www.fire-res.eu

• 2021-2025

Extreme Wildfire Events (EWE) are defined as wildfires with large-scale complex interactions between fire and atmosphere generating pyroconvective behaviour that results in fast, intense, uncertain, and fast-paced changing fire behaviour

➤ **Nevertheless, there might not be a unique factor that is accountable for the definition of extremeness**



2. Database of EWE in Europe in 2000-2022

A fire was included in the EWE database if it comprised at least one of the criteria below:

- (i) extreme fire behavior characteristics and operationality;
- (ii) outlier in fire size at the European scale;
- (iii) outlier/anomaly in historical data at the national scale (fire size and/or magnitude of impacts).

N = 137 EWE



- Literature revision (EFFIS fire reports, scientific and grey literature)
- Statistical analysis for the selection of outliers in fire size at EU scale (EFFIS database with 66549 fires in 2000-2022; $P < 0.001$)



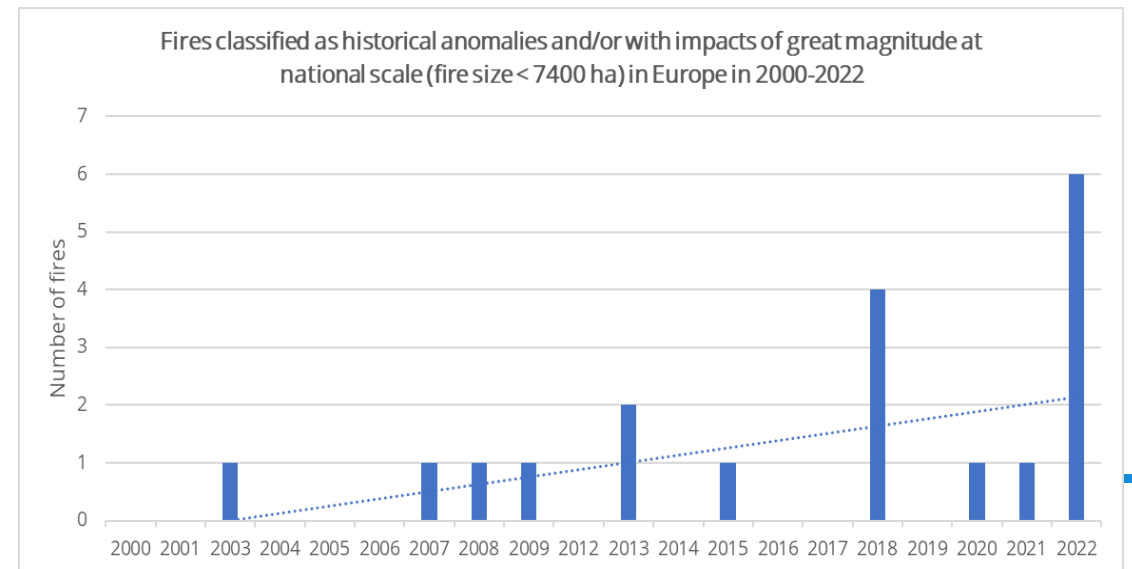
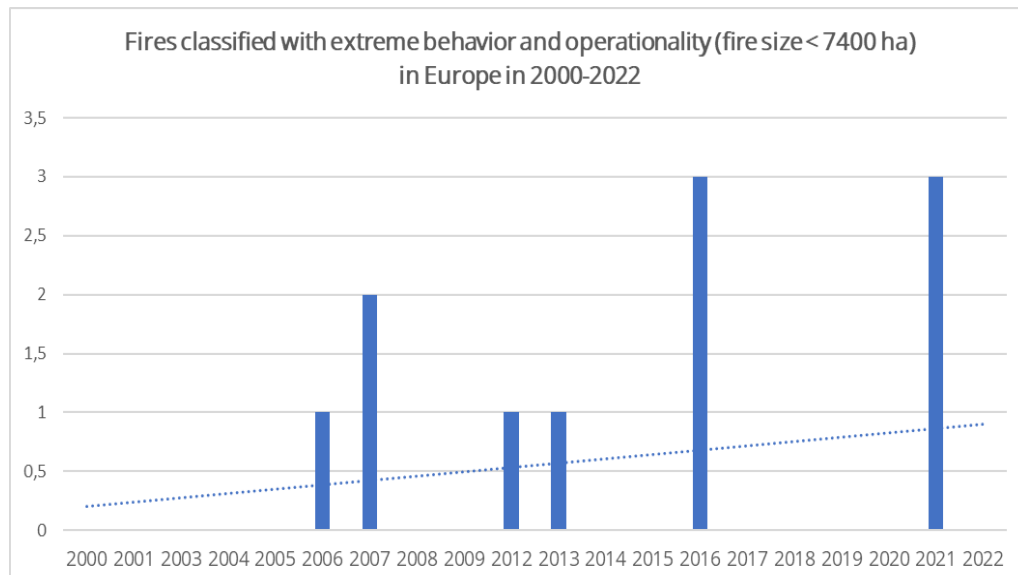
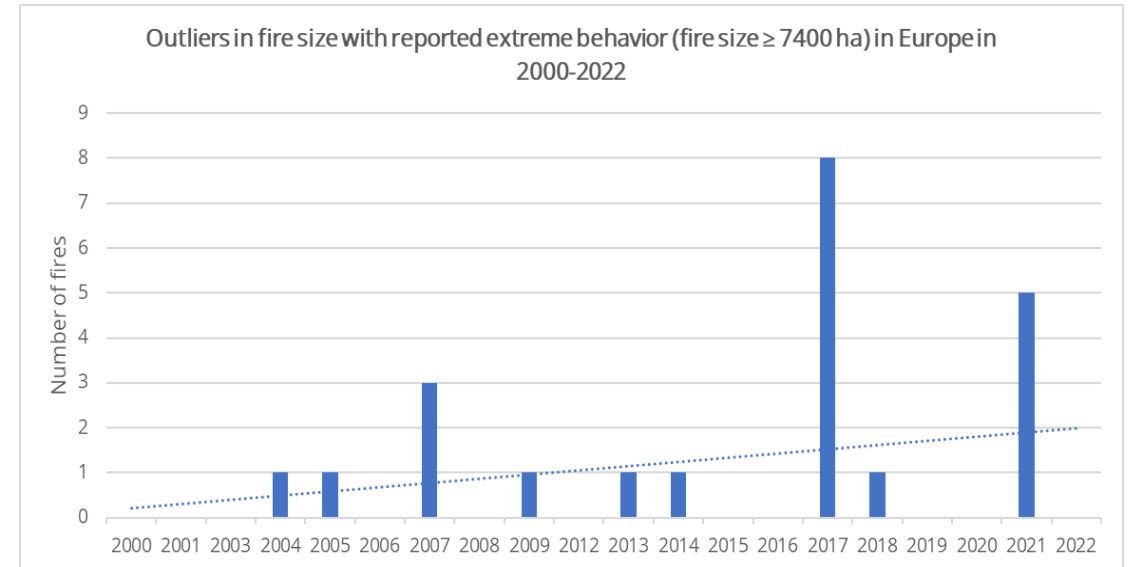
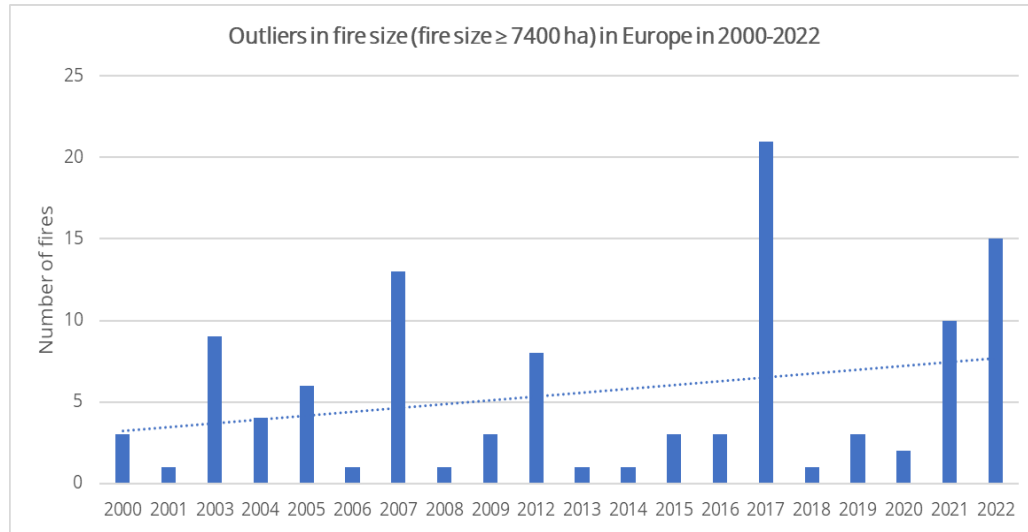
2. Database of EWE in Europe in 2000-2022

Country	Outlier Fire size at EU scale with reported extreme behaviour (≥ 7400 ha)	Outlier Fire size at EU scale (≥ 7400 ha)	Extreme fire behaviour and operationality (< 7400 ha)	Historical anomaly in fire size and/or impacts at national scale (< 7400 ha)	Total
Austria				1	1
Croatia			1		1
Cyprus			2		2
Czech Republic				1	1
France	1	3	2	2	7
Greece	6	12	1		19
Ireland				3	3
Italy	1	5	1	1	8
Latvia				1	1
Netherlands				1	1
Norway				1	1
Portugal	11	33	2		46
Romania		2		2	4
Slovenia				1	1
Spain	3	32		1	36
Sweden	1			4	5
Total	22	87	9	19	137



2. Database of EWE in Europe in 2000-2022

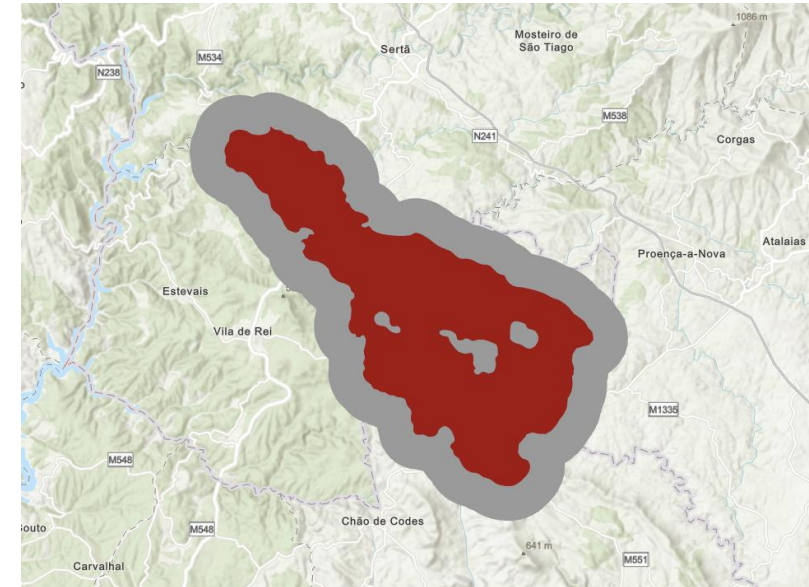
➤ Increasing temporal trend in the occurrence of EWE, for all classification categories





3. Composition and changes of pre-fire landscape

- For each selected EWE, we draw a surrounding unburned buffer with a proportional area
- Corine Land Cover (CLC) data was used to quantify pre-fire LULC composition and transitions within fire polygons and unburned buffers in 1990-2018
 - 9 classes: artificial surfaces, agricultural areas, broad-leaved forest, coniferous forest, mixed forest, scrublands and herbaceous associations, open spaces, burnt areas, wetlands*
- Pre-fire LULC difference (% points) between unburned buffers and fire polygons



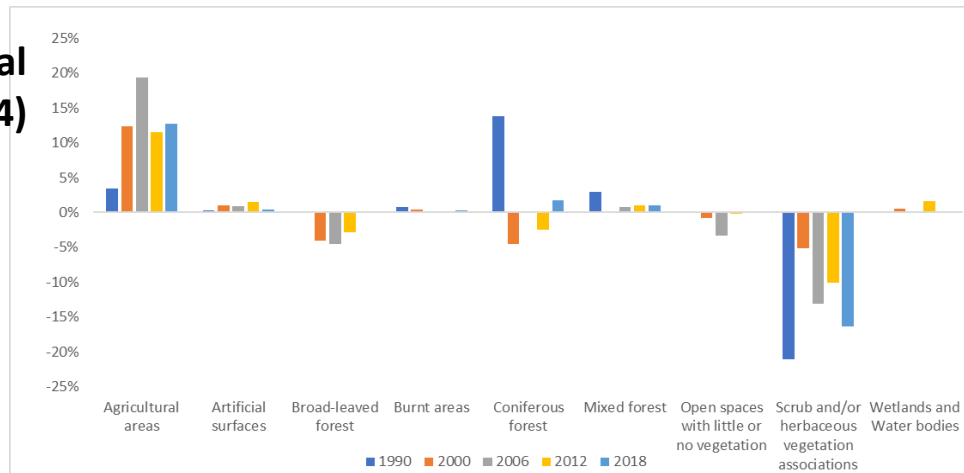


3. Composition and changes of pre-fire landscape

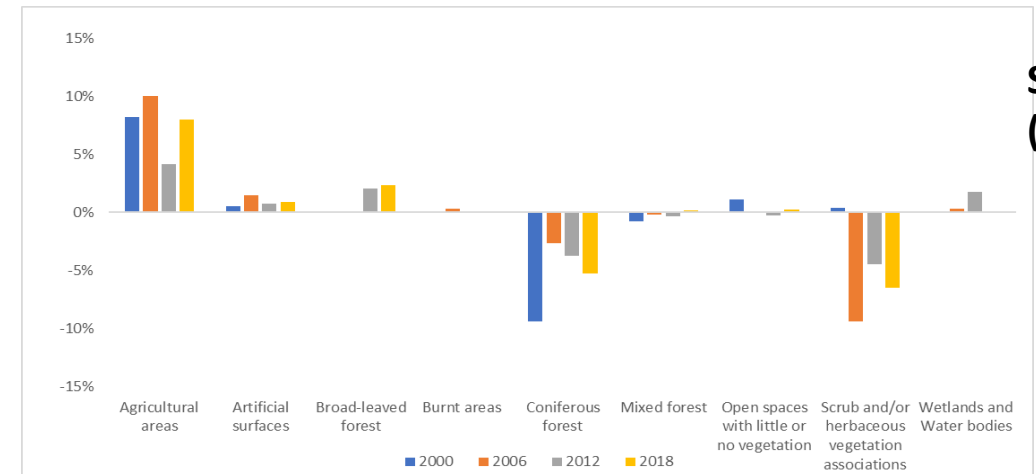
☐ EWE classified as outliers in fire size at EU scale (≥ 7400 ha)

Differences in Pre-fire LULC composition between Unburned Buffers and Fire Polygons (% points) in 1990-2018

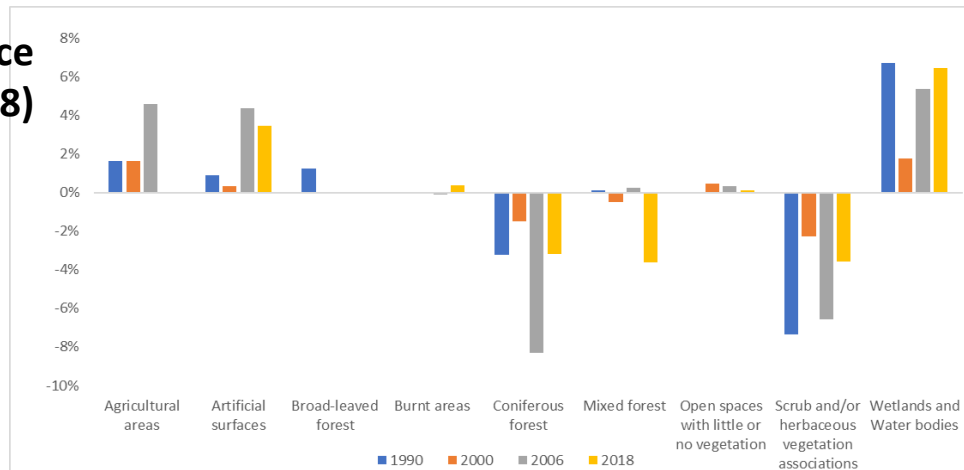
Portugal
(N = 44)



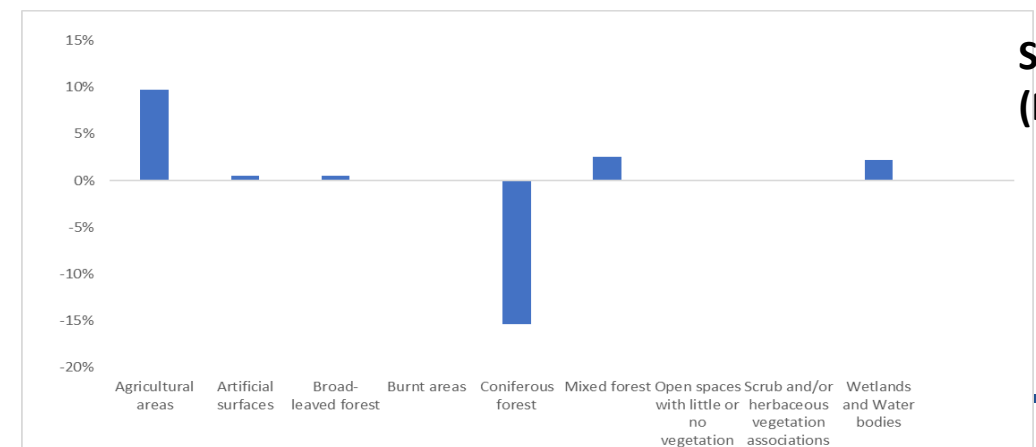
Spain
(N = 35)



Greece
(N = 18)



Sweden
(N = 1)





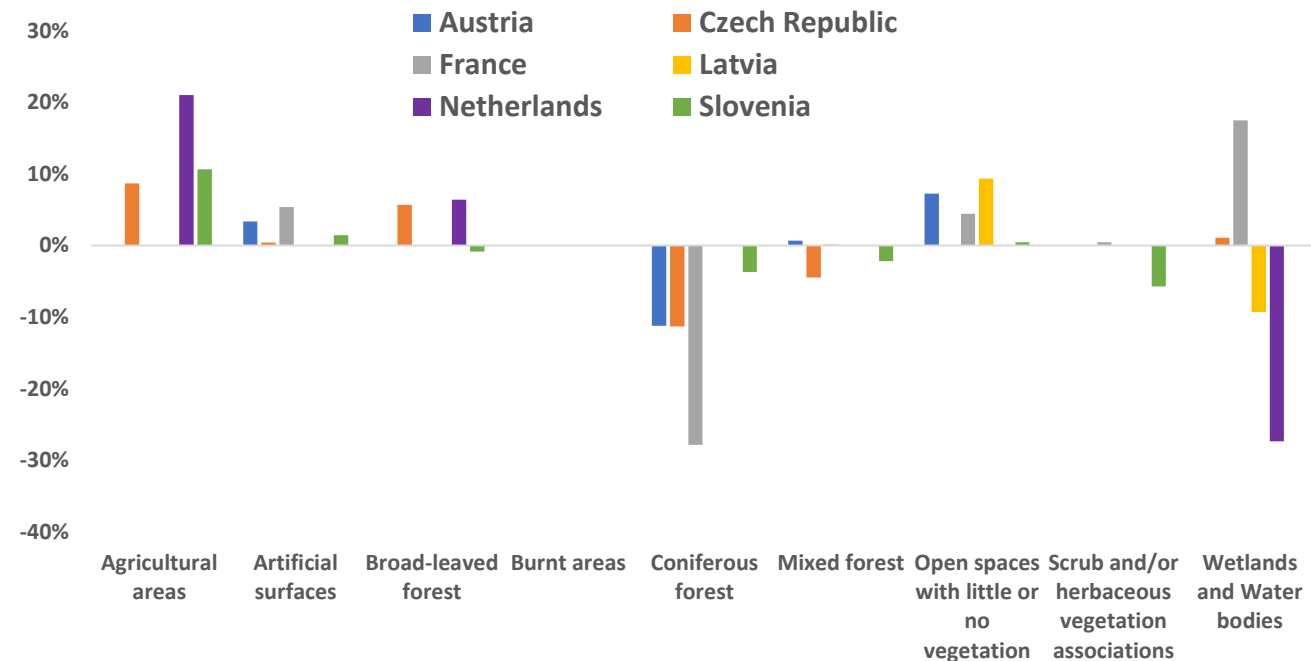
3. Composition and changes of pre-fire landscape

□ EWE classified as historical anomalies at national scale

(ranging from 100 ha in Austria to 7000 ha in France)

- ✓ Agricultural land area was higher within unburned buffers, with the largest difference found for the Netherlands (20% difference, 2020-fire with 710 ha of size)
- ✓ In countries without a traditional fire history (e.g., Netherlands, Latvia and Norway), the area occupied by wetlands (peatlands) in the pre-fire landscape was higher within fire polygons

Differences in Pre-fire LULC composition between Buffers and Fire Polygons in 2018 (% points)



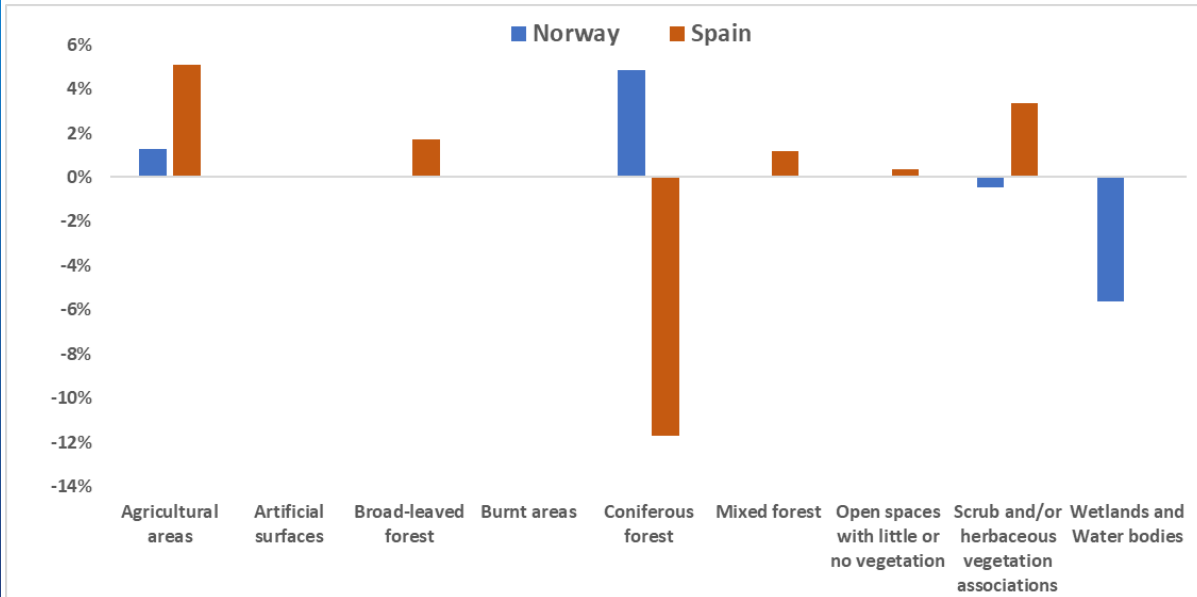


3. Composition and changes of pre-fire landscape

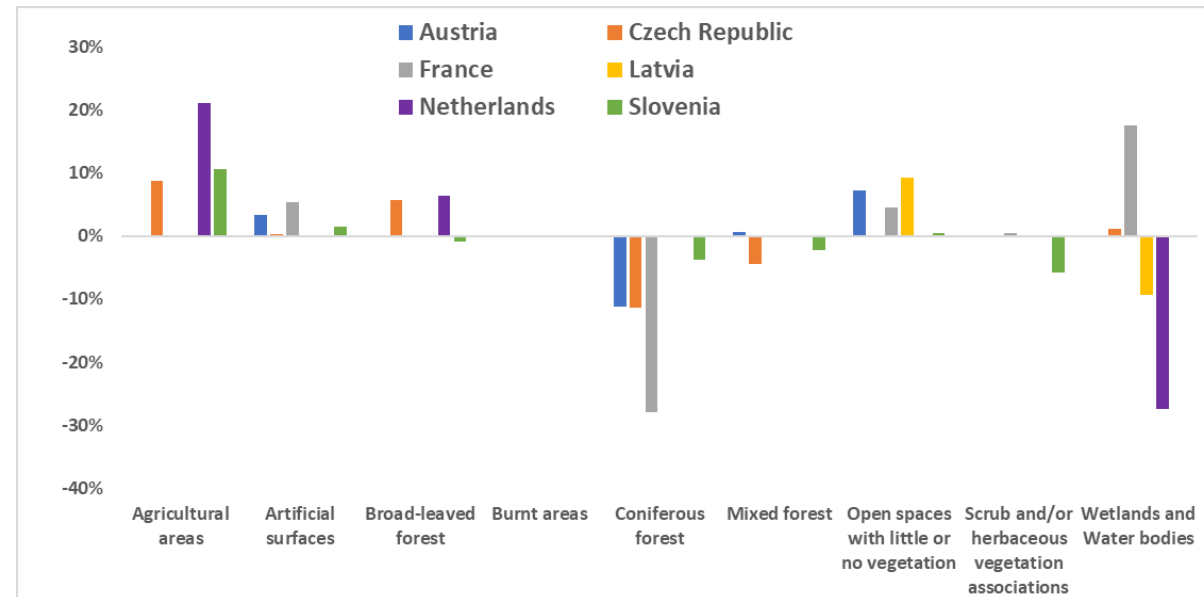
□ EWE classified as historical anomalies at national scale

Differences in Pre-fire LULC composition between Unburned Buffers and Fire Polygons (% points)

LULC in 2006 for EWE in 2008-2012



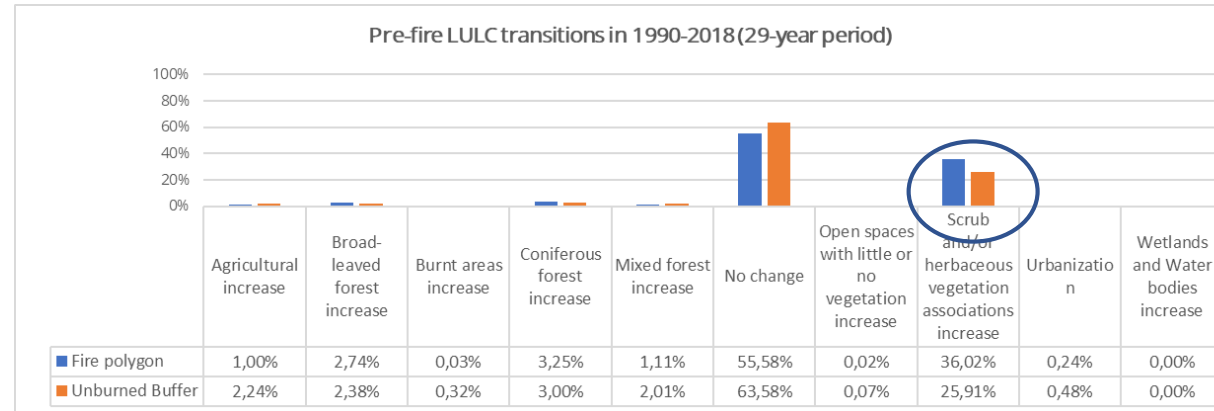
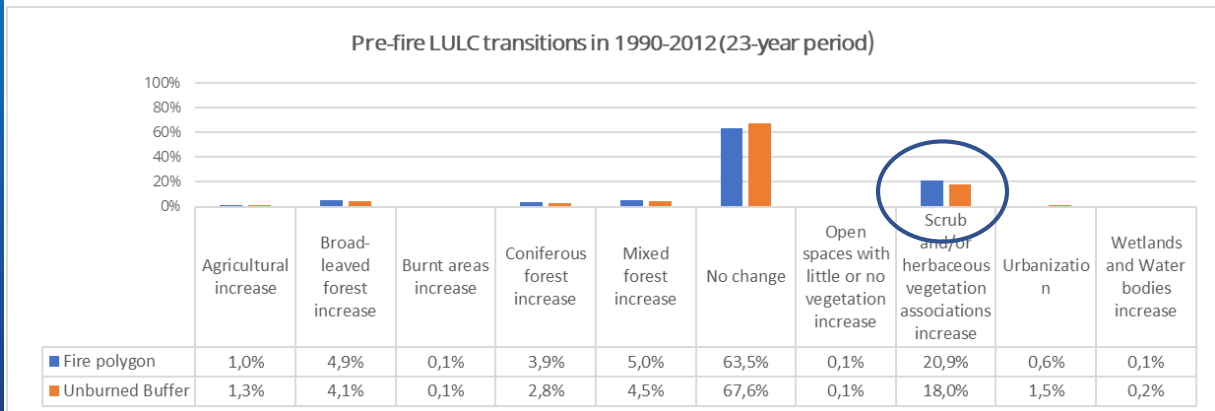
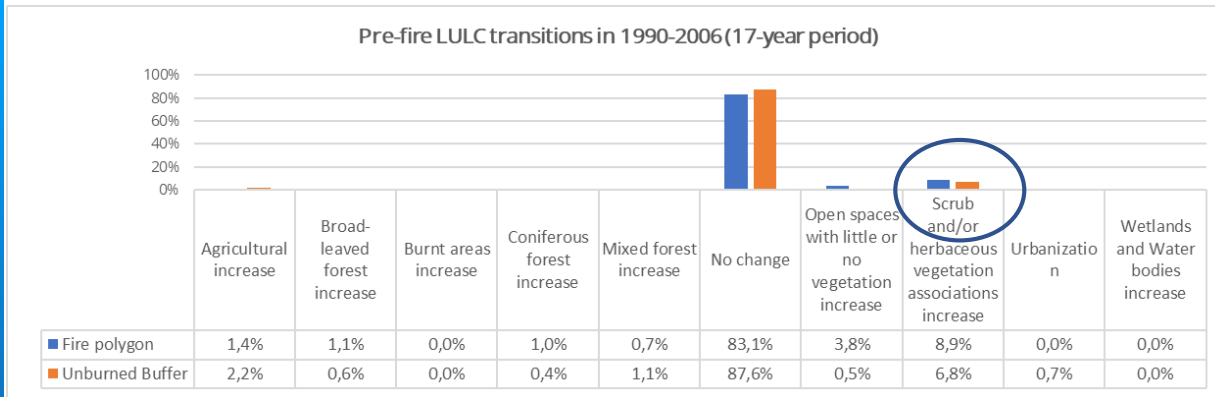
LULC in 2018 for EWE in 2019-2022





3. Composition and changes of pre-fire landscape

Pre-fire LULC transitions in fire polygons and unburned buffers for outliers in fire size in Portugal

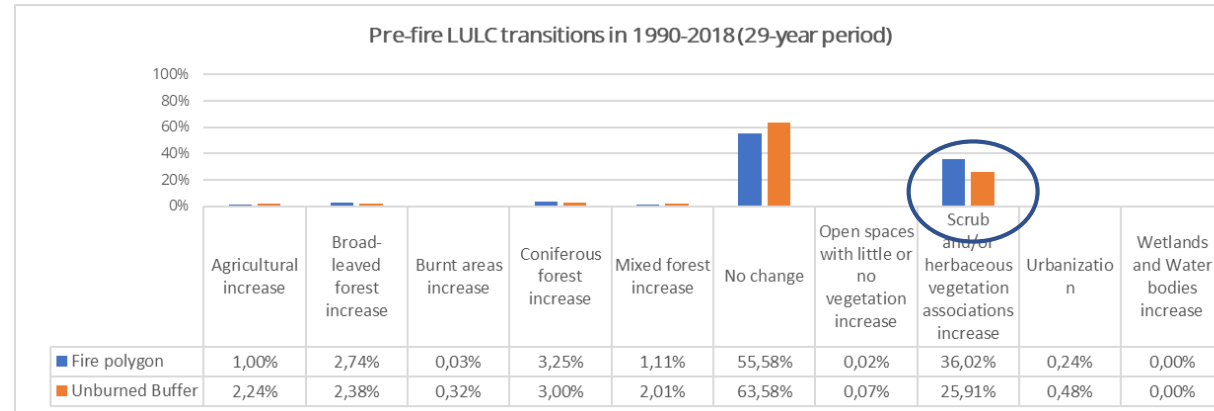
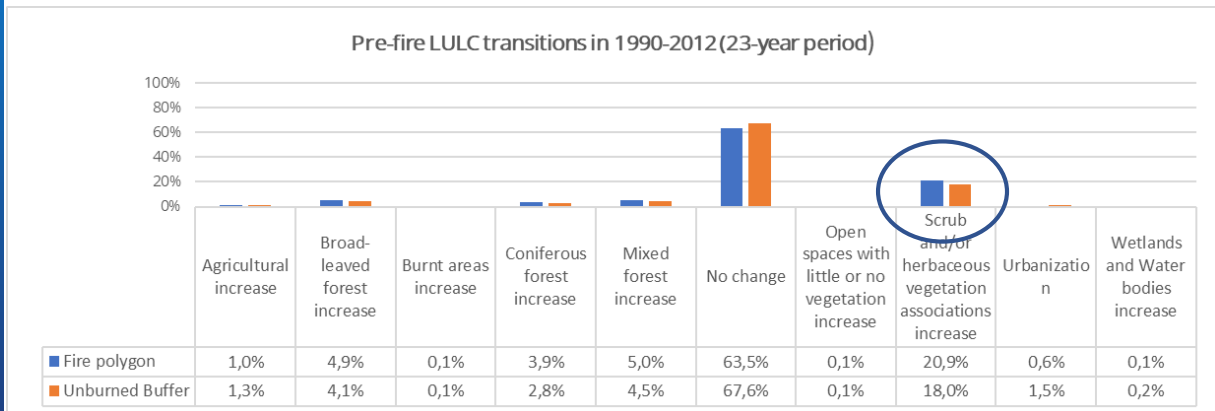
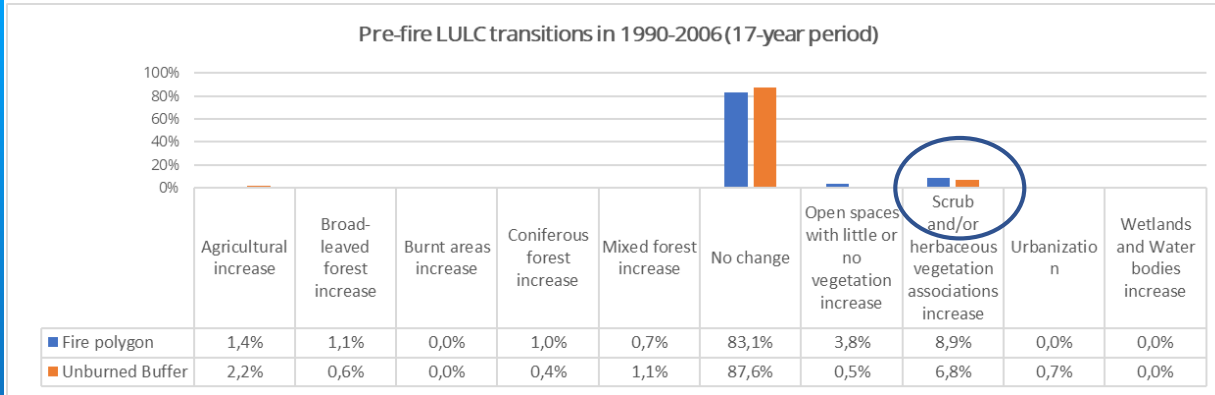




3. Composition and changes of pre-fire landscape

Pre-fire LULC transitions in fire polygons and unburned buffers for outliers in fire size in Portugal

Scrublands gained more area within fire polygons than within unburned buffers; this difference increases in time





4. Diversity of pre-fire landscape

Shannon Diversity of pre-fire landscape composition in 2018 (Fires occurred in 2019-2022)

	EWE Polygon		Unburned Buffer	
	Min	Max	Min	Max
Austria	1,00	1,00	1,19	1,19
Czech Republic	0,64	0,64	1,07	1,07
Cyprus	1,11	1,11	1,15	1,15
France	0,49	1,11	1,20	1,46
Greece	0,97	1,68	1,07	1,72
Italy	1,07	1,16	1,25	1,32
Latvia	0,27	0,27	0,47	0,47
Netherlands	0,60	0,60	1,03	1,03
Portugal	0,69	1,36	0,86	1,38
Romania	0,00	0,58	0,18	0,74
Slovenia	1,33	1,33	1,47	1,47
Spain	0,83	1,29	1,03	1,47

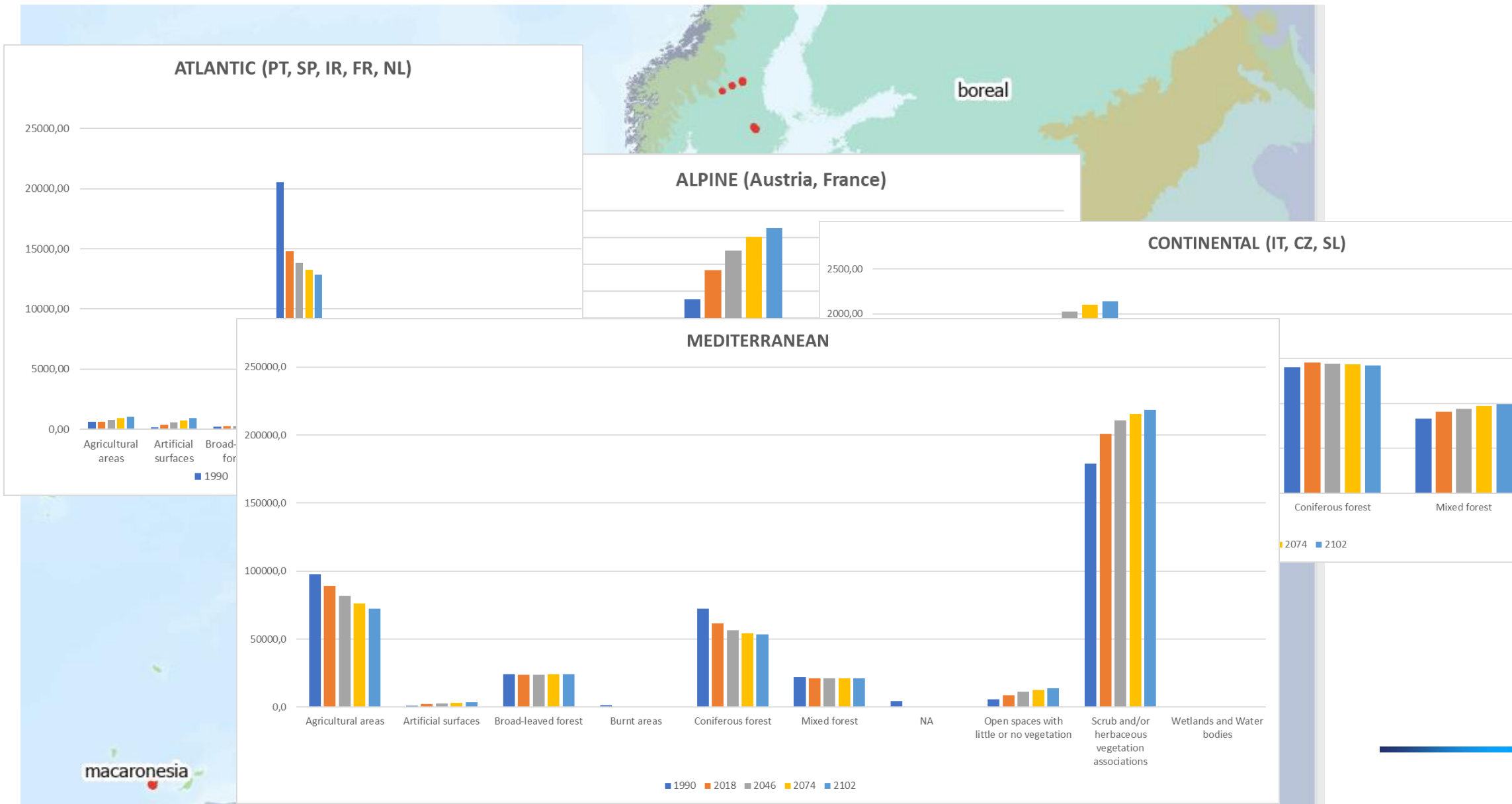
Landscape diversity is higher in unburned areas surrounding EWE

Diversity metrics is influenced by:

- **Richness** (the number of different patch types present)
- **Evenness** (the distribution of area among the patch types)

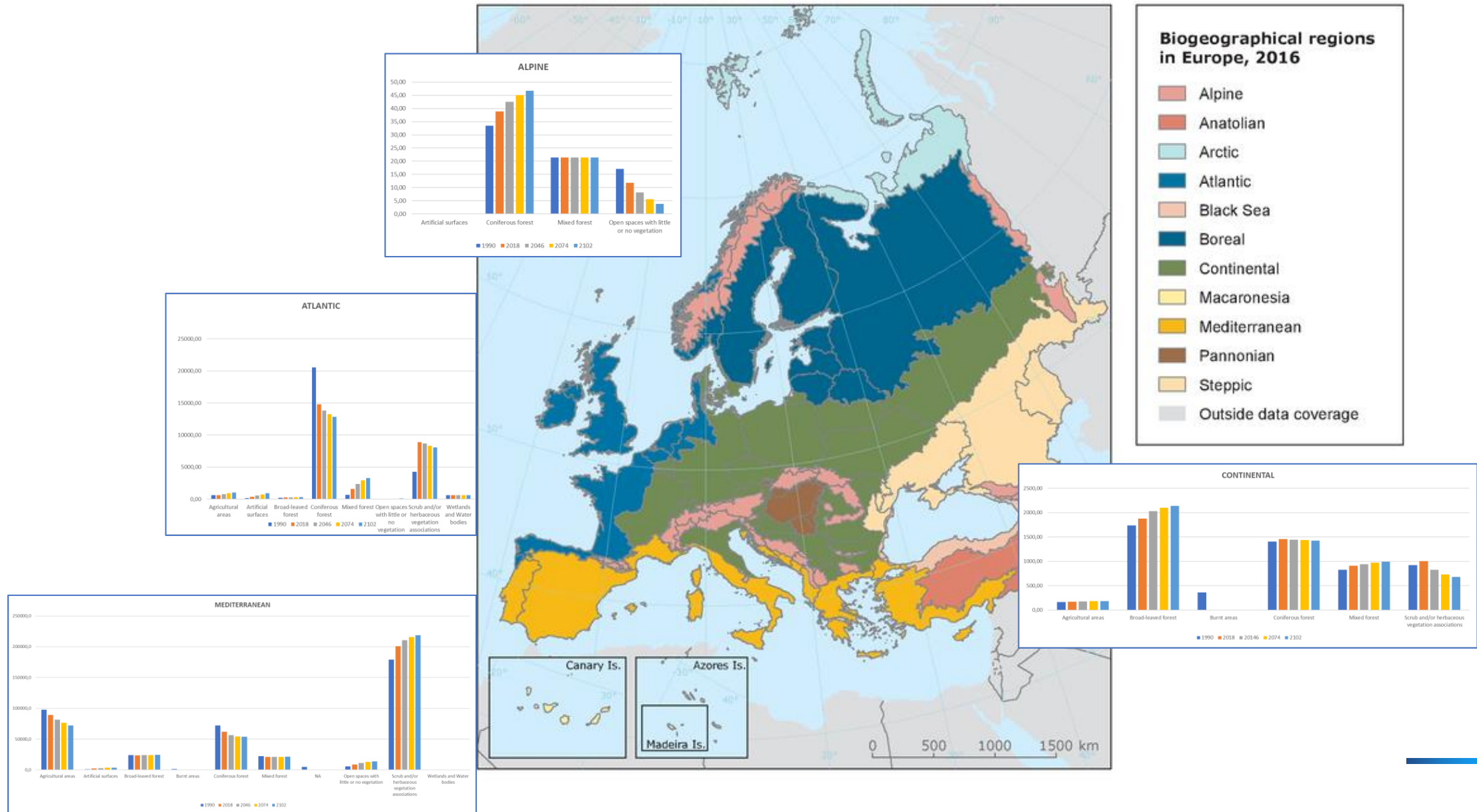


5. Simulation of future landscapes in biogeographical regions in Europe





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Summary

- ❑ More agricultural land area in unburned polygons shows very consistent patterns across European countries – agricultural mosaics are indeed important for fire-resilient forest landscapes
- ❑ More scrubland area in EWE polygons (than in surrounding unburned areas), consistently among Mediterranean countries, especially for Portugal, which shows increasing gains in scrubland area within fire polygons in time (increasing land abandonment?)
- ❑ Landscape composition is less diverse in EWE polygons than in surrounding unburned areas
- ❑ Simulations suggest increasing wildfire risk in Mediterranean landscapes in the future due to increasing scrubland area
- ❑ Peatlands may turn into a landscape with an increasing wildfire risk, due to the high flammability of dry peat soils, as peatlands dry out from climate change (a similar pattern has been observed in Canadian wildfires)



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