Wildfires in the rural environment of Spain at the crossroad of increased severe weather and fire hazard due to abandonment

José Manuel Moreno

Royal Spanish Academy of Sciences

O barco de Valdeorras, July 2022

Content

- Current trends of wildfires and their drivers
- Wildfires with Civil Protection incidence
- Wildfires and climate relationships
- Projections under climate change
- Conclusions

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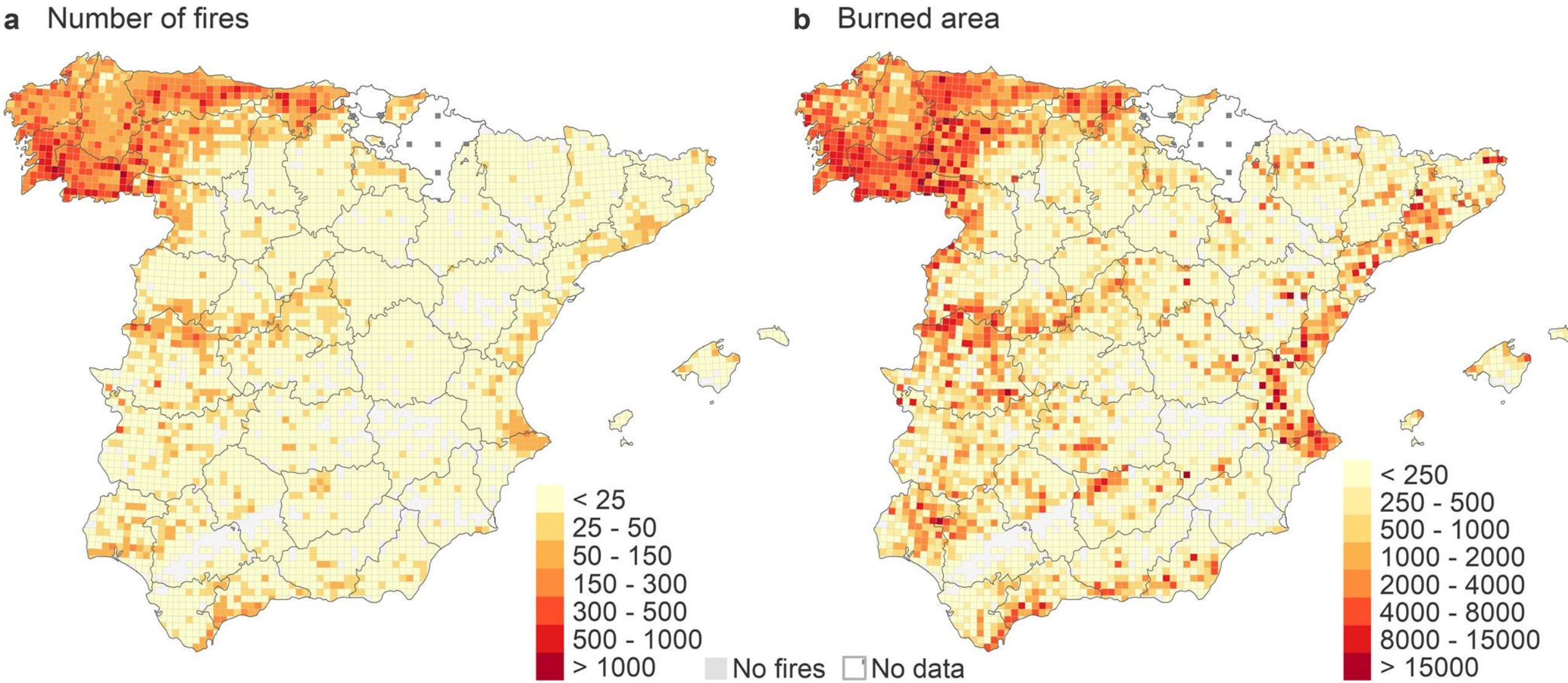
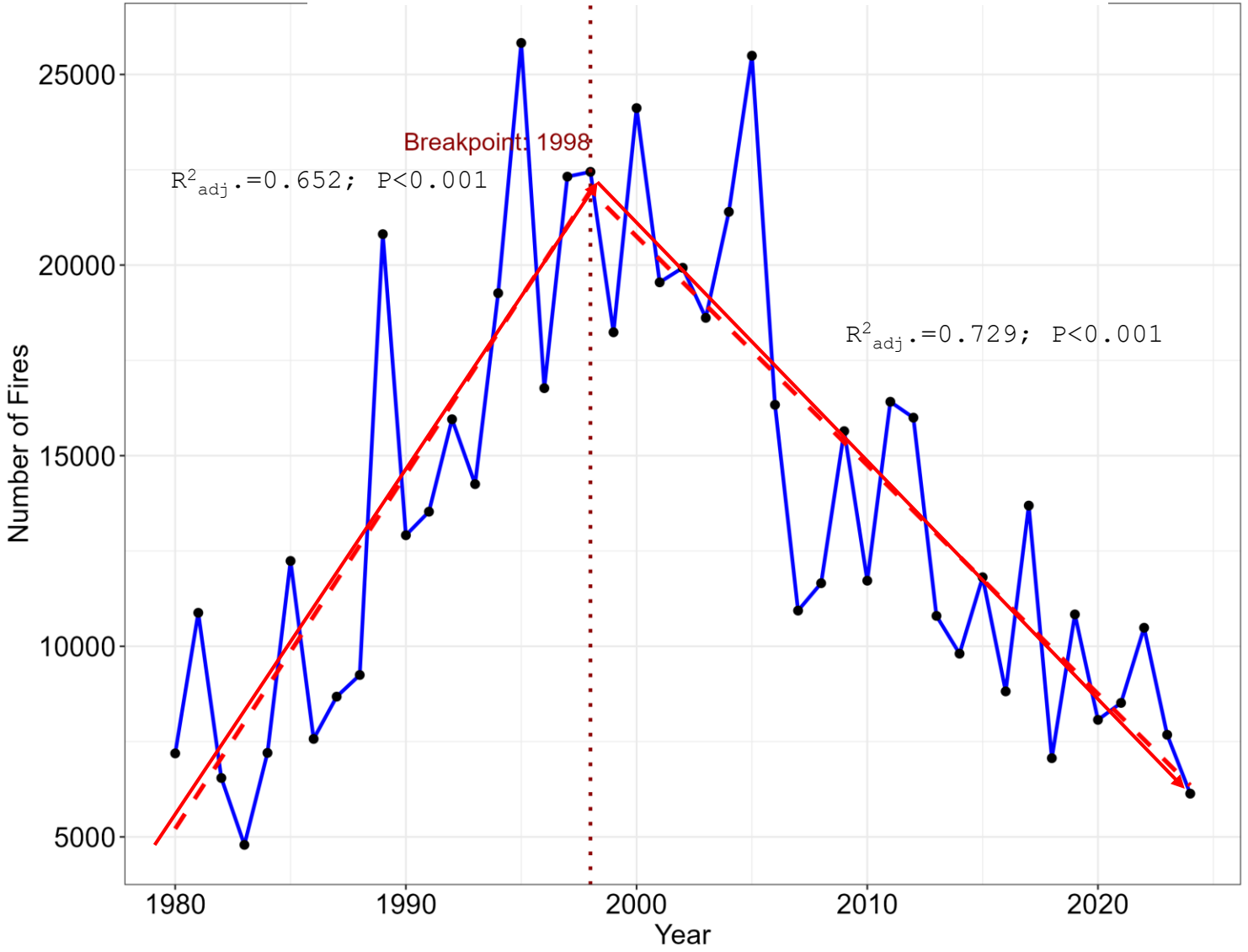
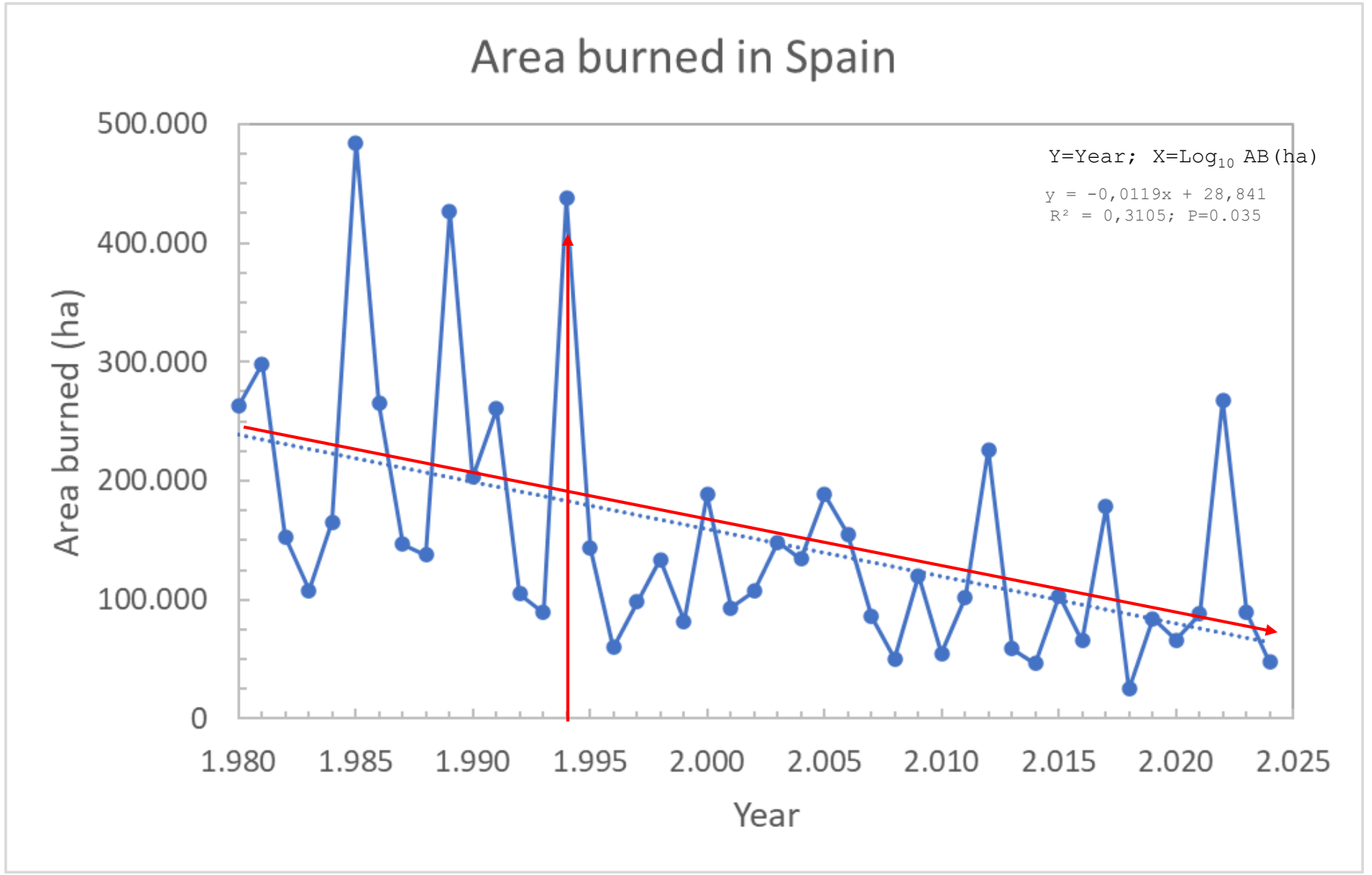


Fig. 1 a Total number of fires and b total burned area (ha) per 10 × 10 km grid cell accumulated for 1980–2013 in Peninsular Spain and the Balearic Islands. For trend analysis, data were aggregated at the provincial (gray polygons) and country level. De Urbieta et al. 2019: Annals of Forest Science (2019) 76:90

Number of wildfires in Spain



Data from EGIF



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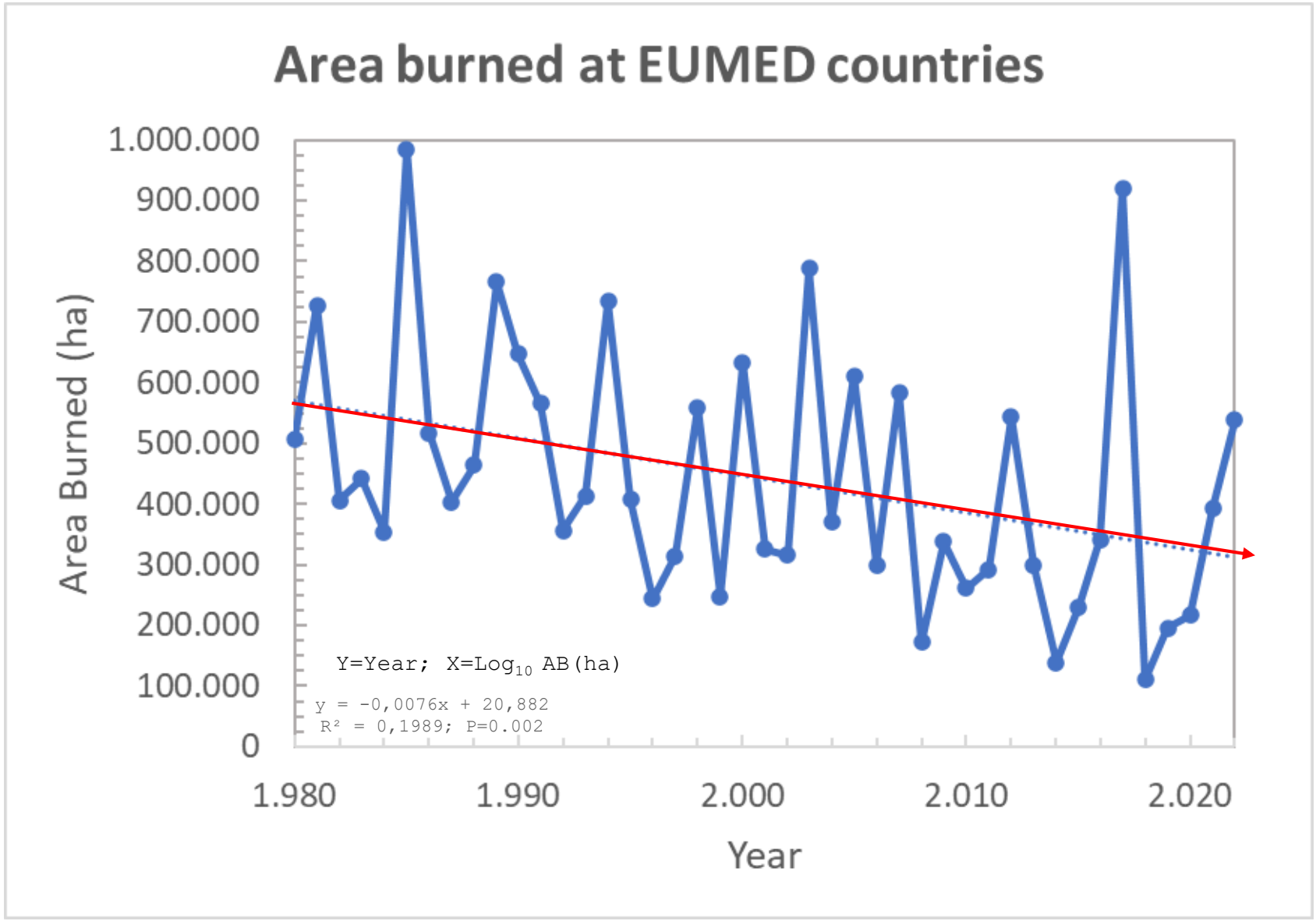


Data from EFFIS

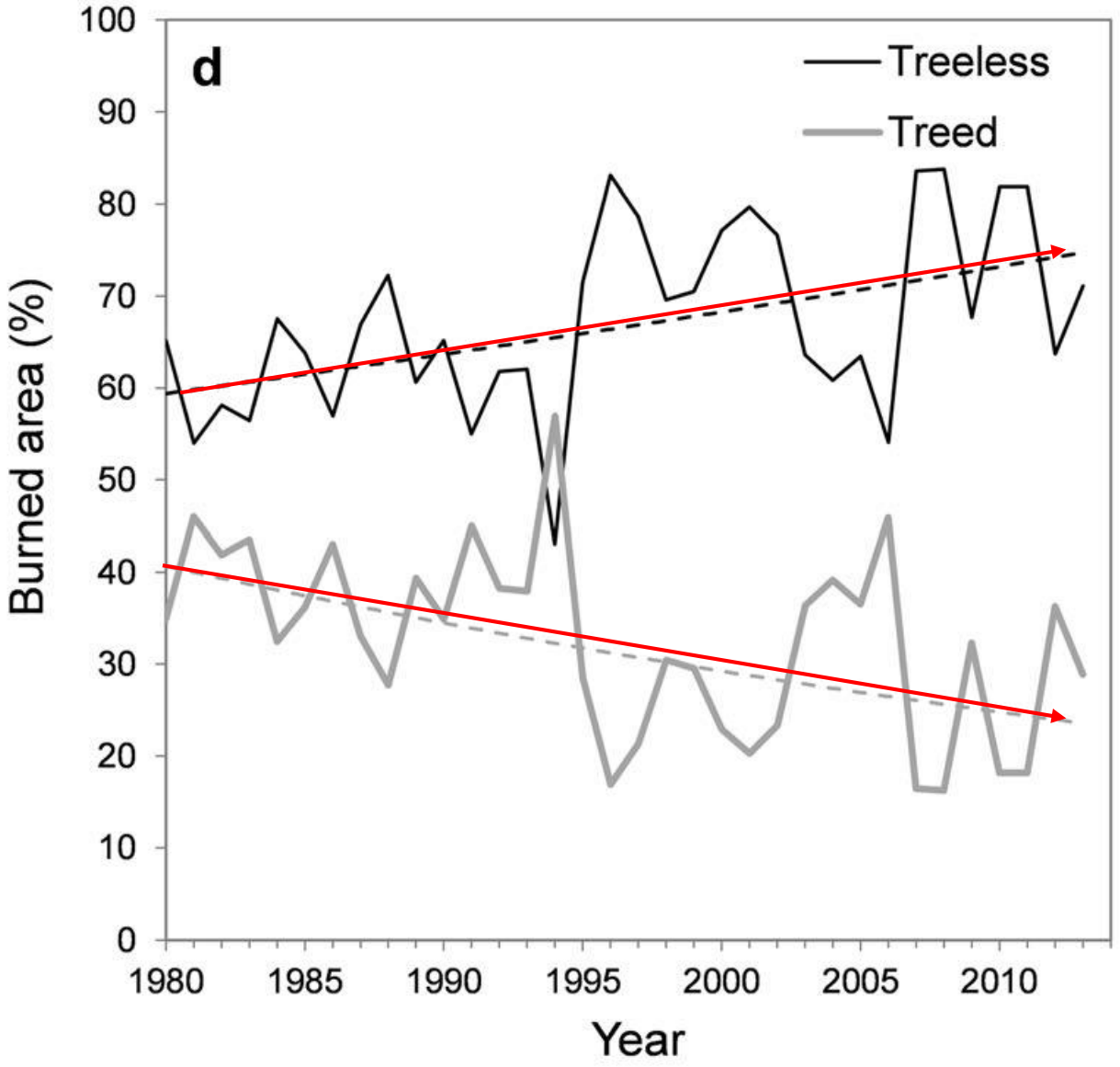
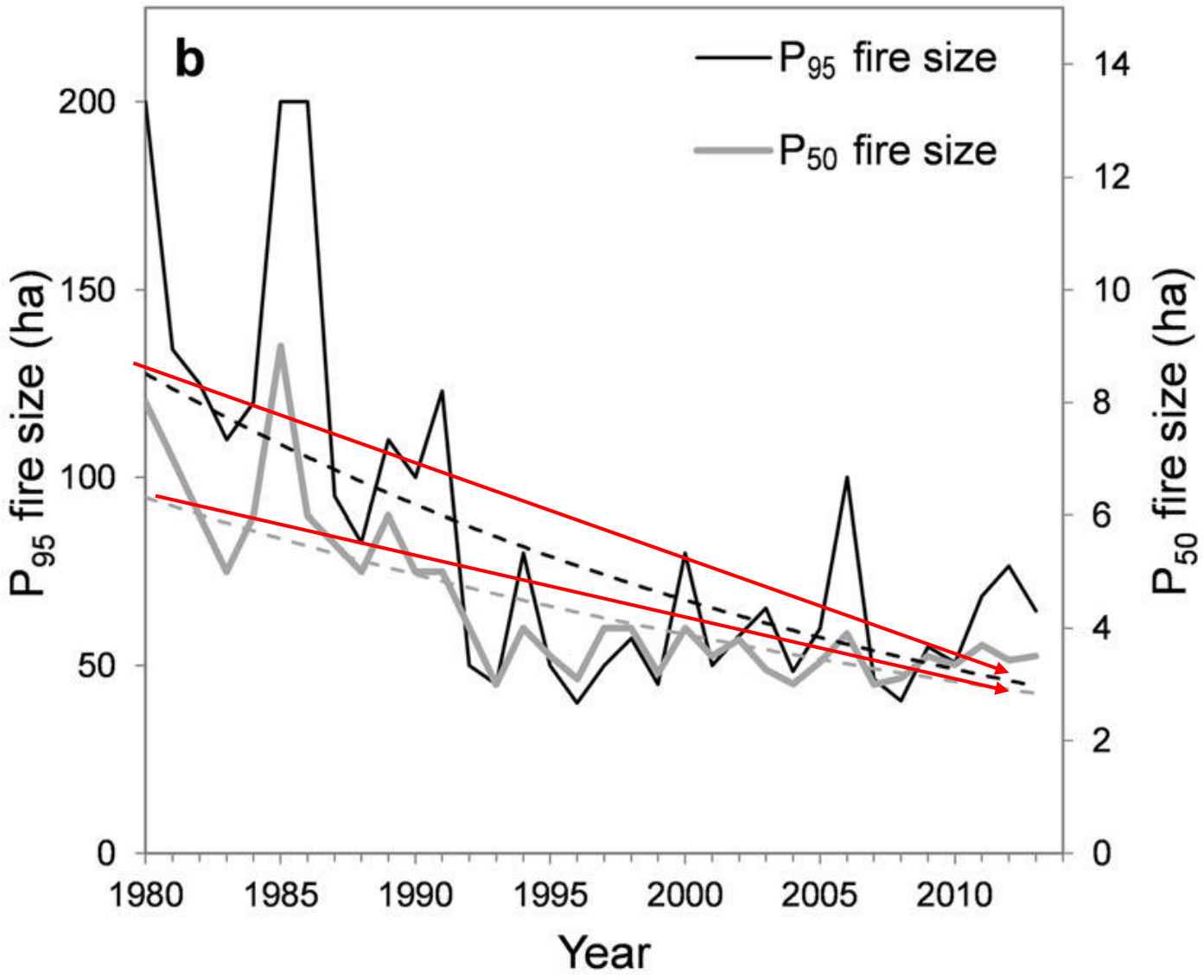


Fig. 2 Fire data annual series for Peninsular Spain and the Balearic Islands (1980–2013). a Number of fires and total burned area (ha). B P50 and P95 of fire size (ha). c Treed and treeless burned area (ha). D Treed and treeless burned area (%). e Burned area (ha) of Pinus species and Quercus species. f Pinus and Quercus burned area (%) relative to total treed burned area. A loess smoothing line is shown for significant trends (p <



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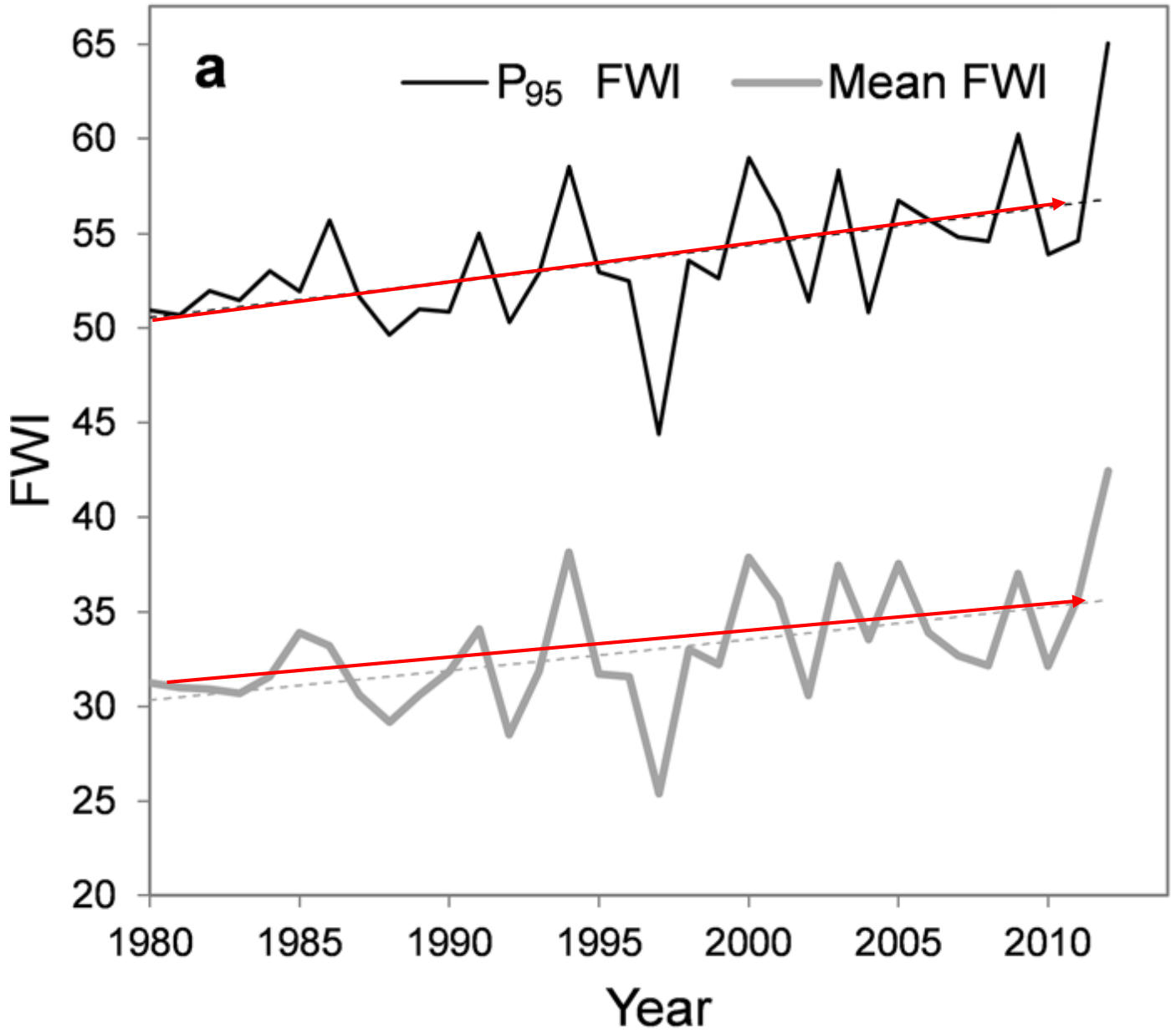
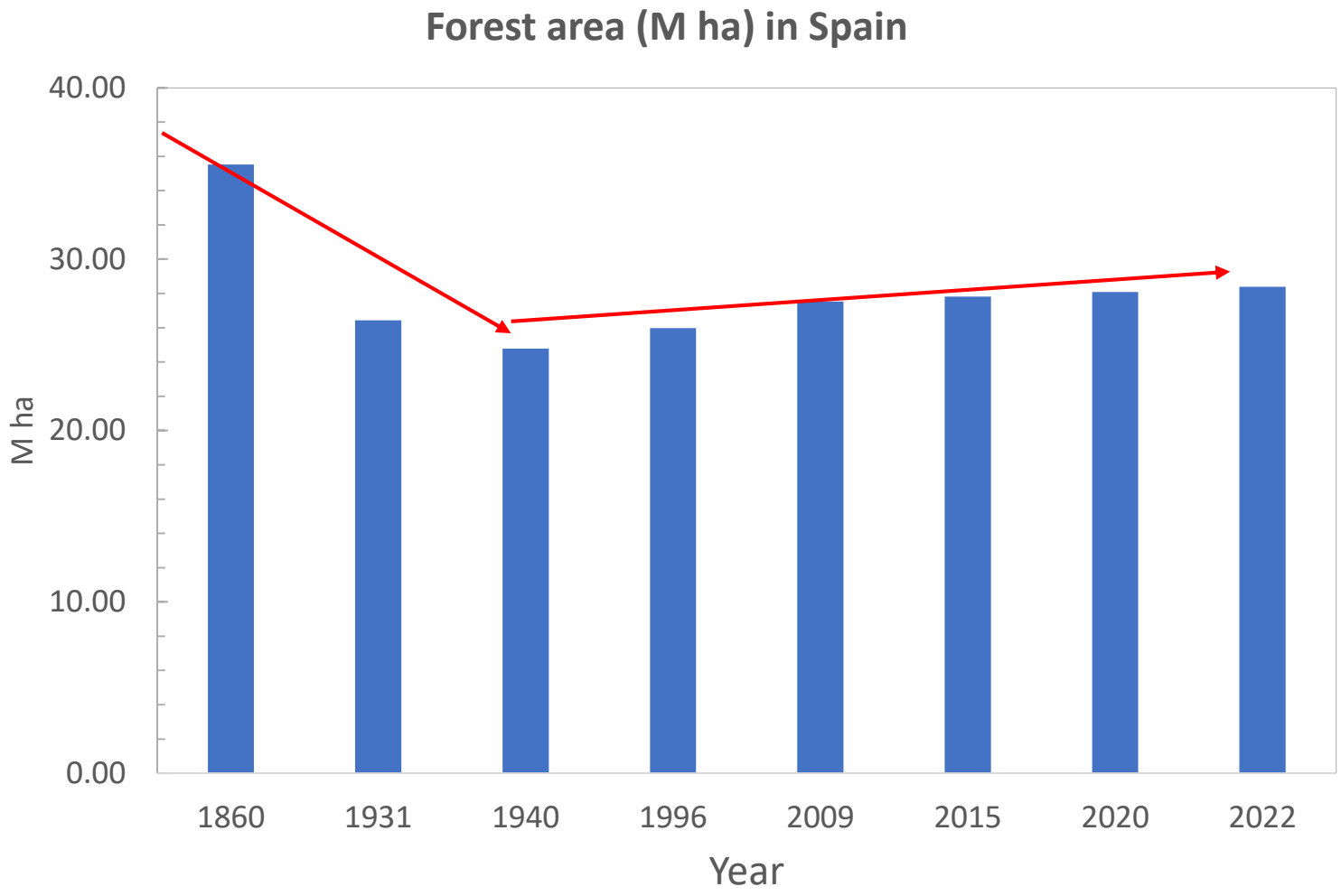
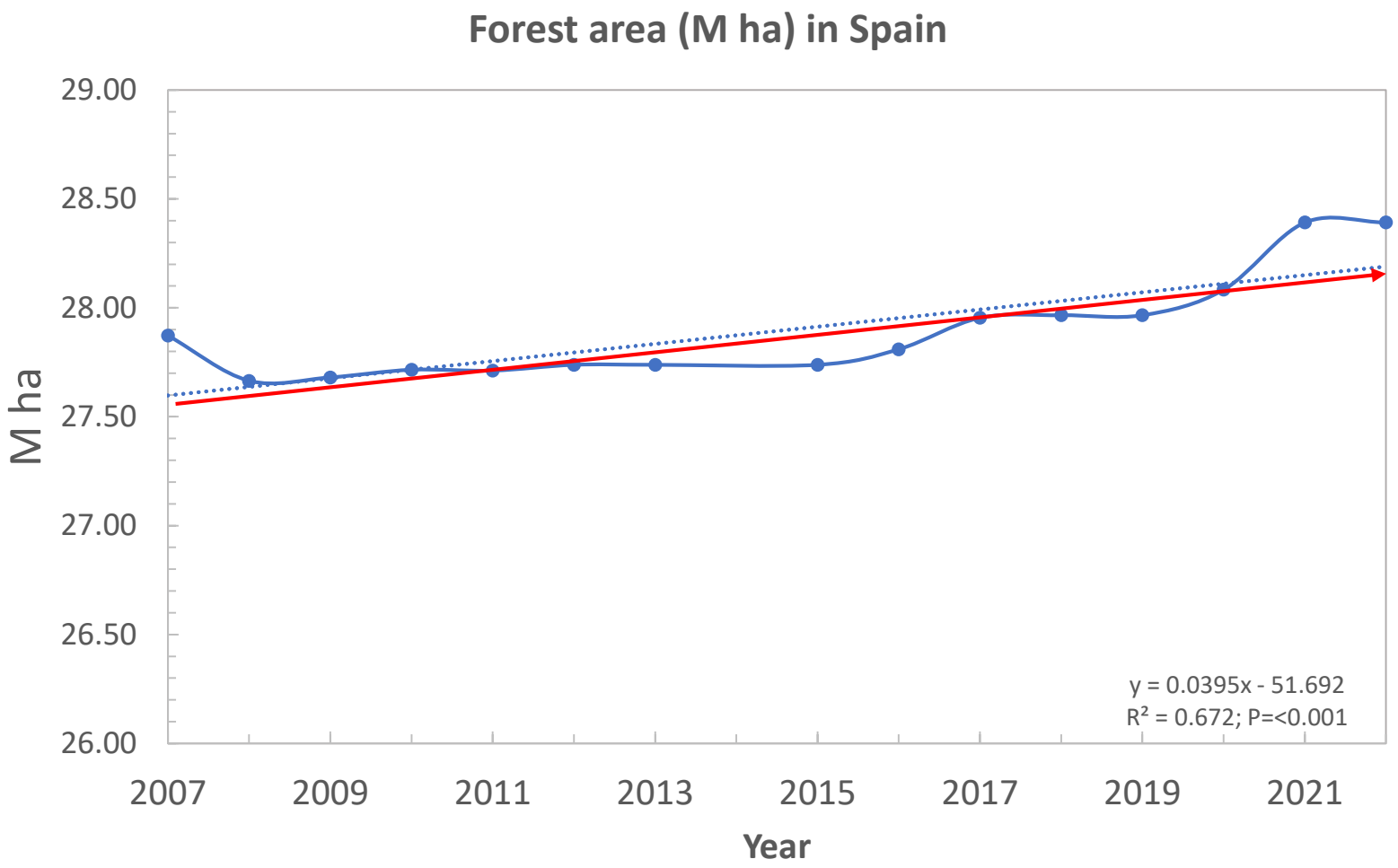


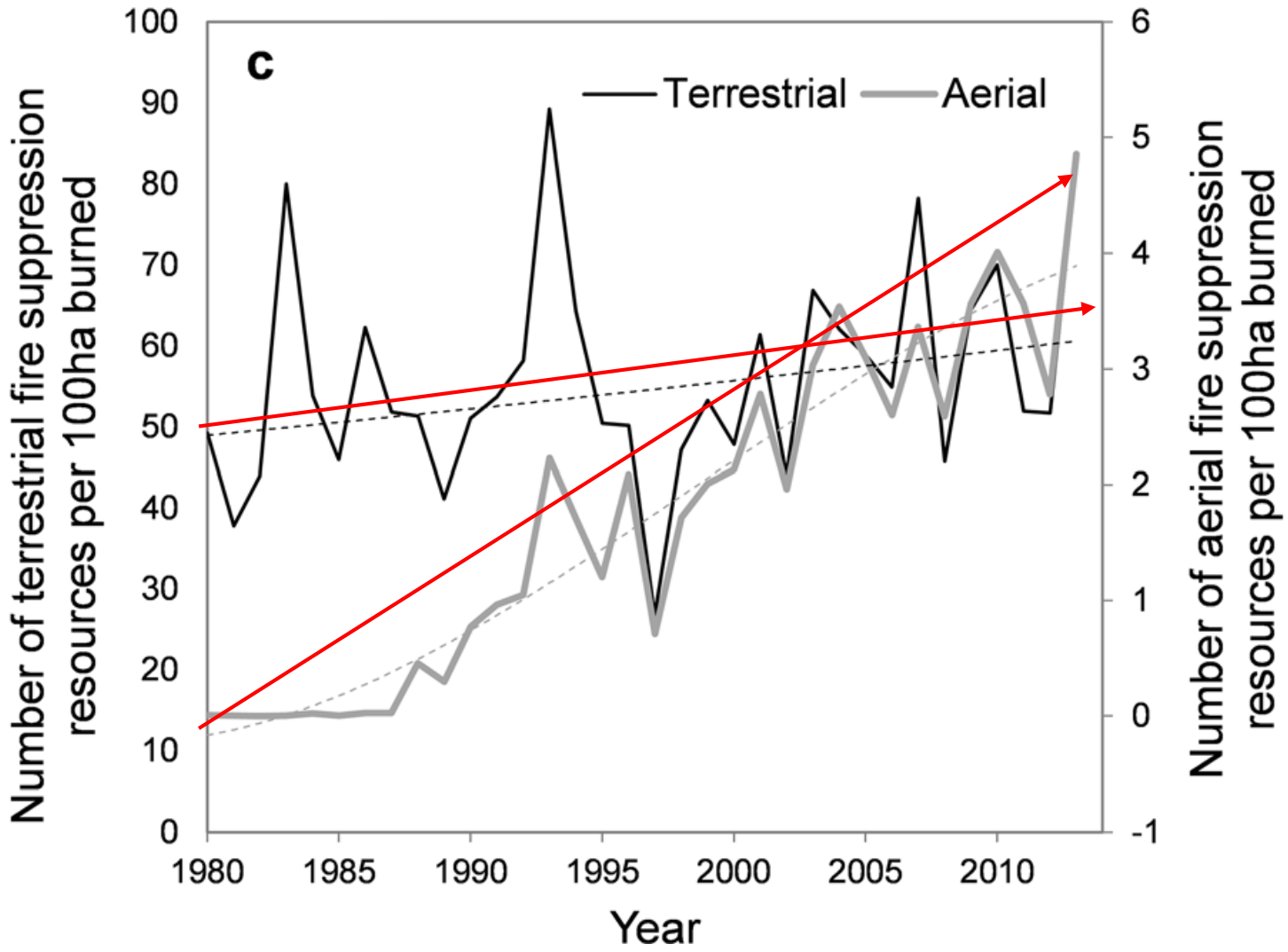
Fig. 6 Trends of fire risk factors for Peninsular Spain and the Balearic Islands (1980–2013). A Summer (JJAS) mean FWI and P95 FWI. b LULC changes (%) based on CORINE Land Cover (CLC) maps for forest and semi natural, agricultural, and artificial areas. c Average number of terrestrial and aerial fire suppression resources invested per 100 ha burned for fires > 50 ha. A loess



From Bravo et al 2017 ISFE
and Anuario de Estadística F



Data from Anuario de Estadística Forestal



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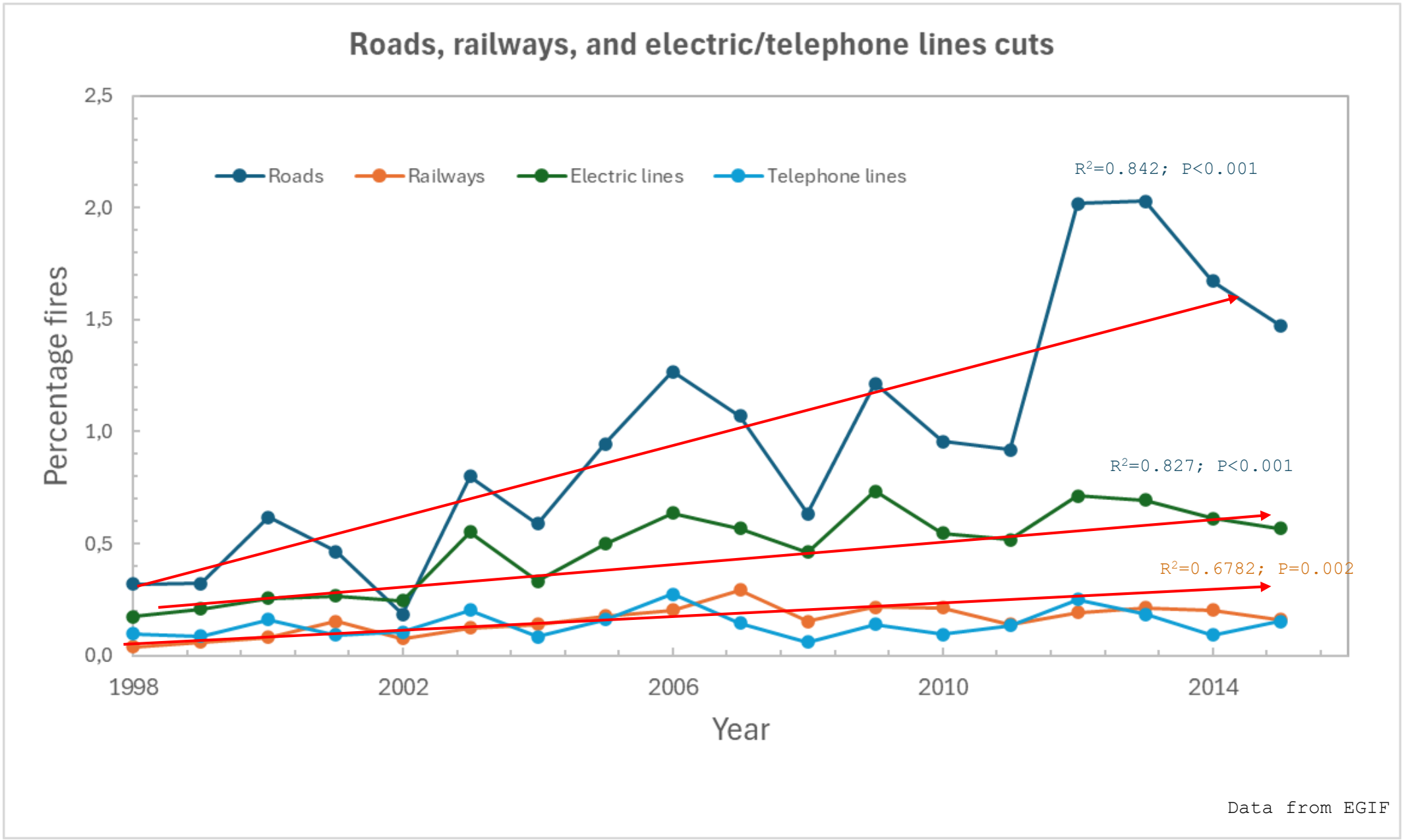
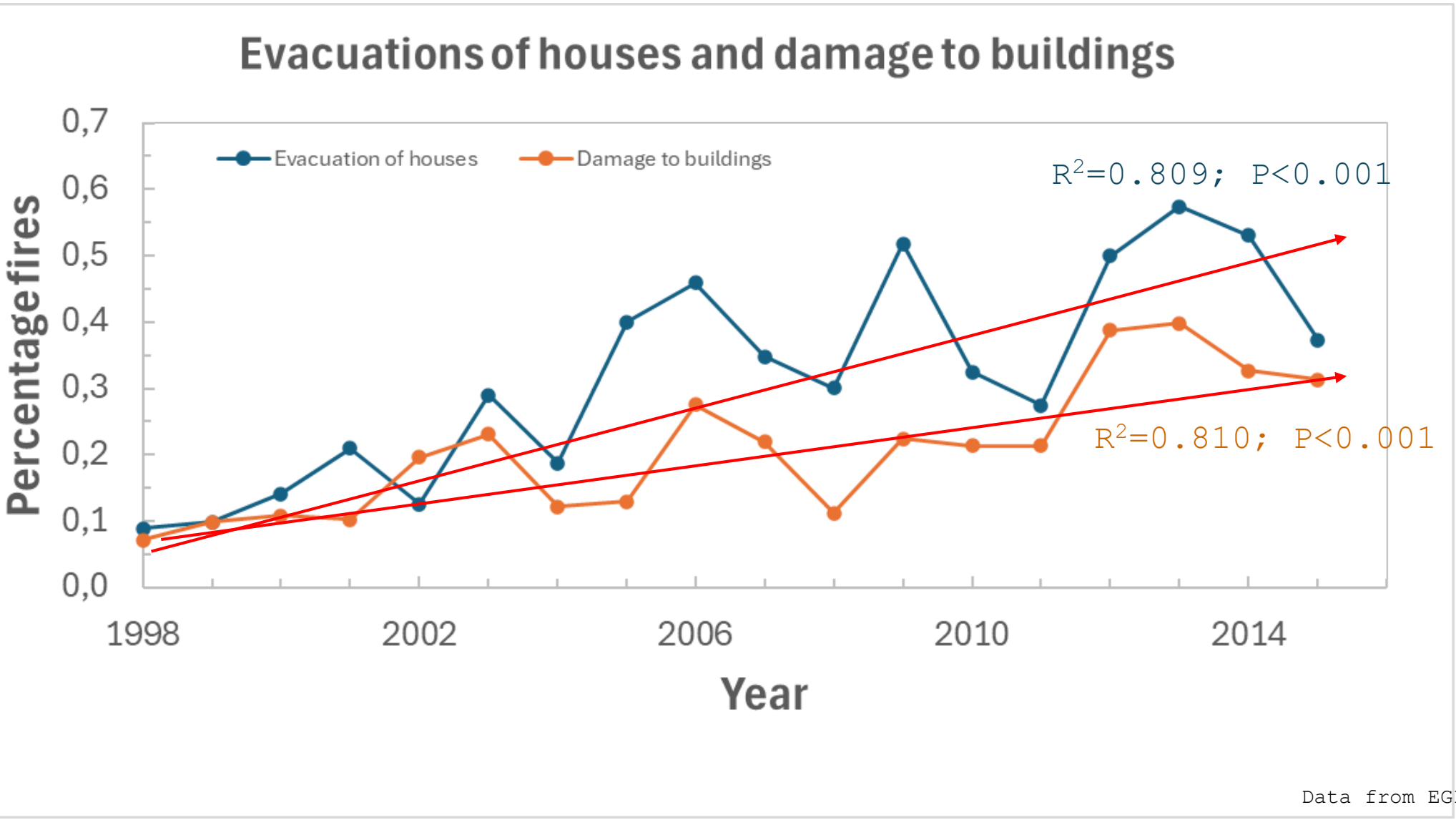
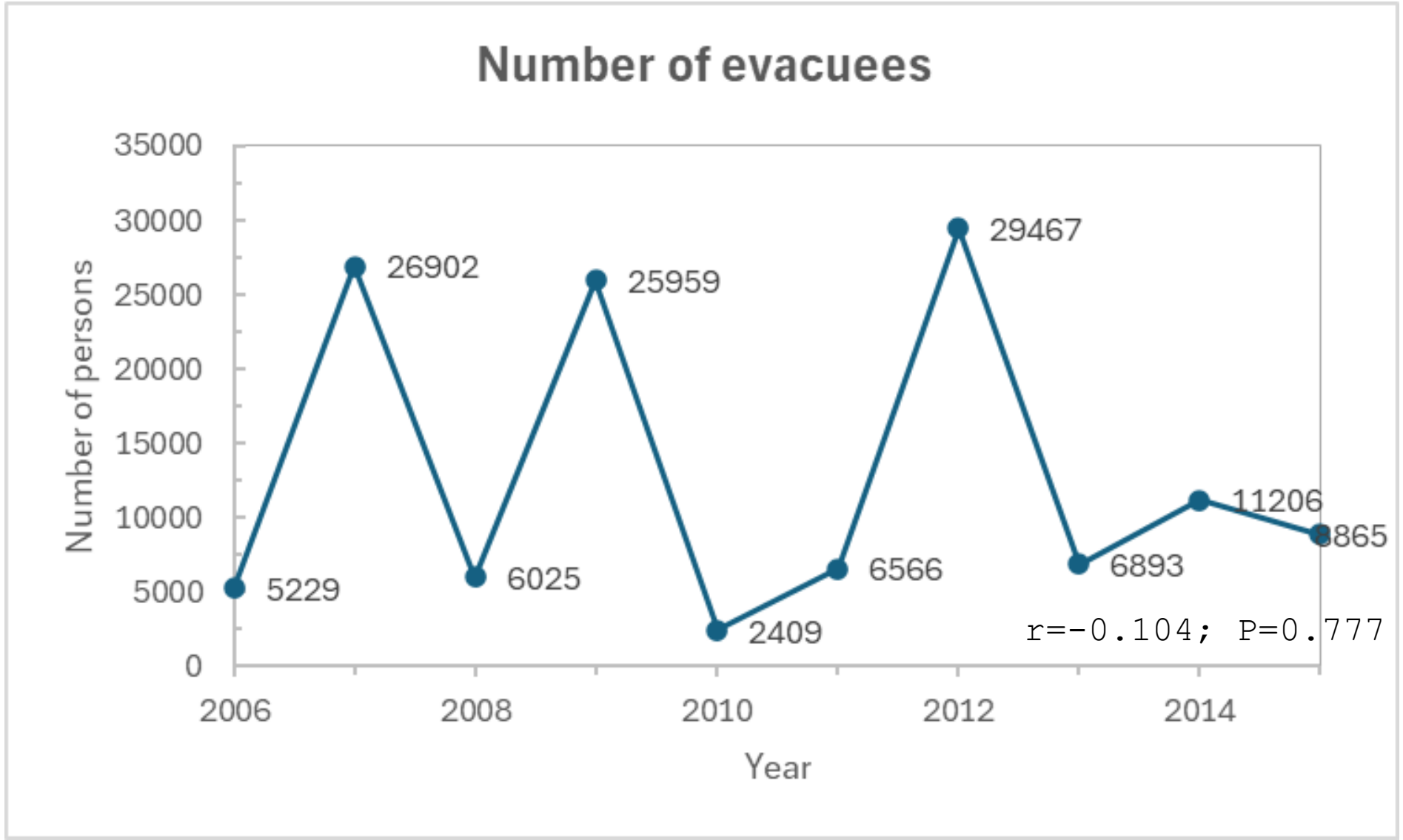

Roads, railways, and electric/telephone lines cuts
Roads
Railways
Electric lines
Telephone lines
R²=0.842; P<0.001
R²=0.827; P<0.001
R²=0.6782; P=0.002
Percentage fires
2,5
2,0
1,5
1,0
0,5
0,0
1998
2002
2006
2010
2014
Year
Data from EGIF

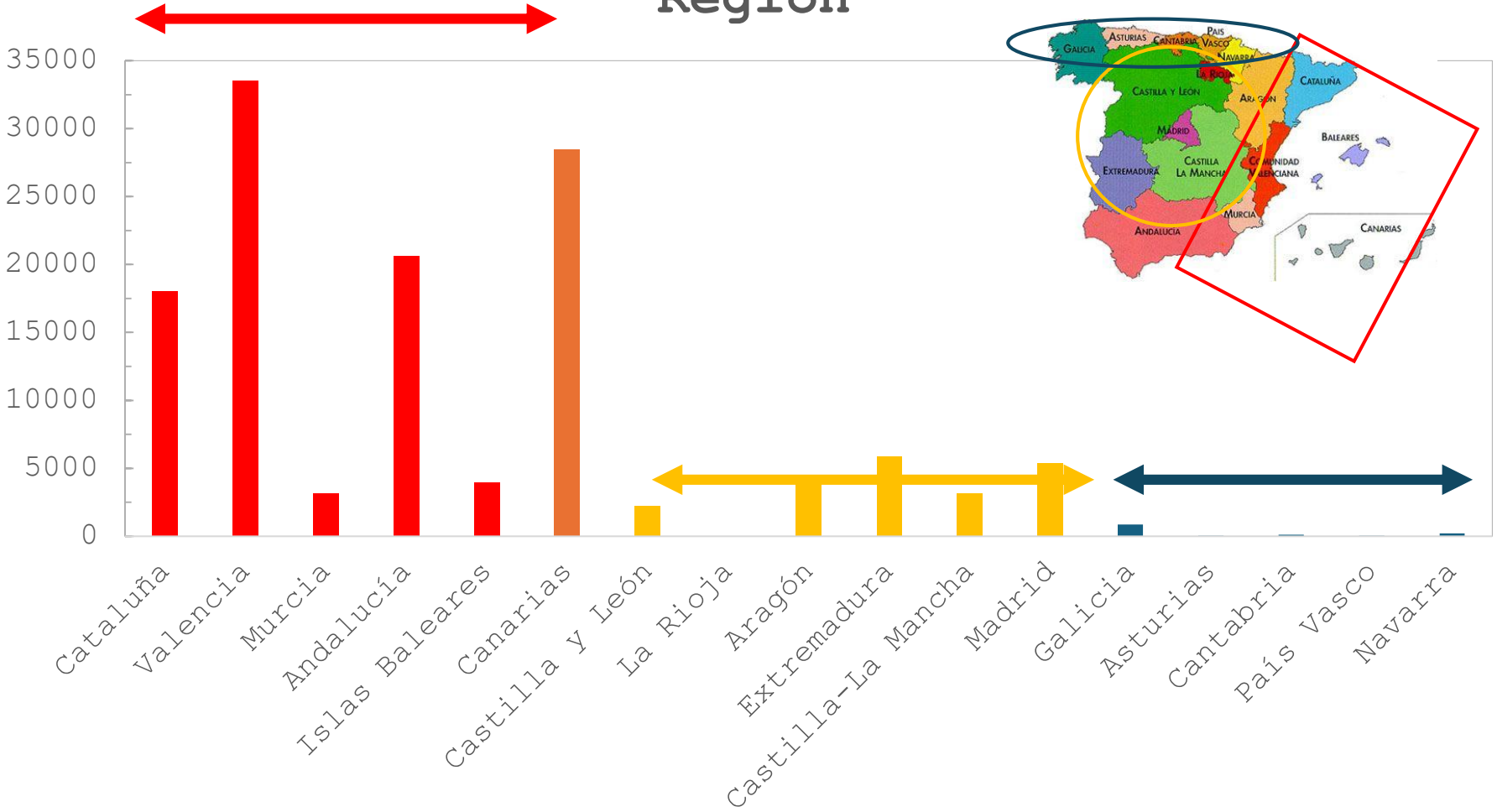


Data from EGIF

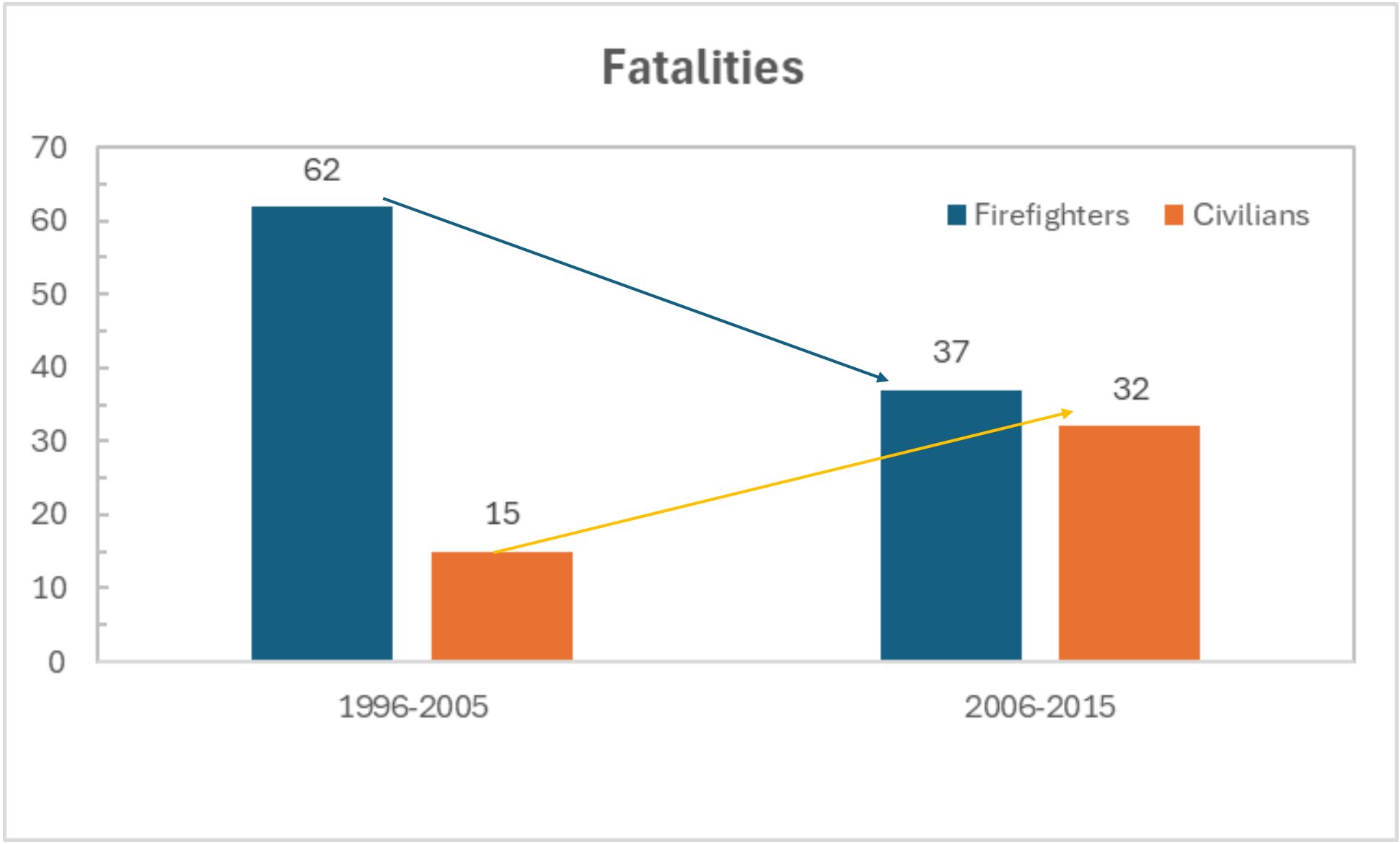

Number of evacuees
35000
30000
25000
20000
15000
10000
5000
0
Number of persons
5229
26902
6025
25959
2409
6566
29467
6893
11206
8865
r=-0.104; P=0.777
2006
2008
2010
2012
2014
Year

Sour: EGIF

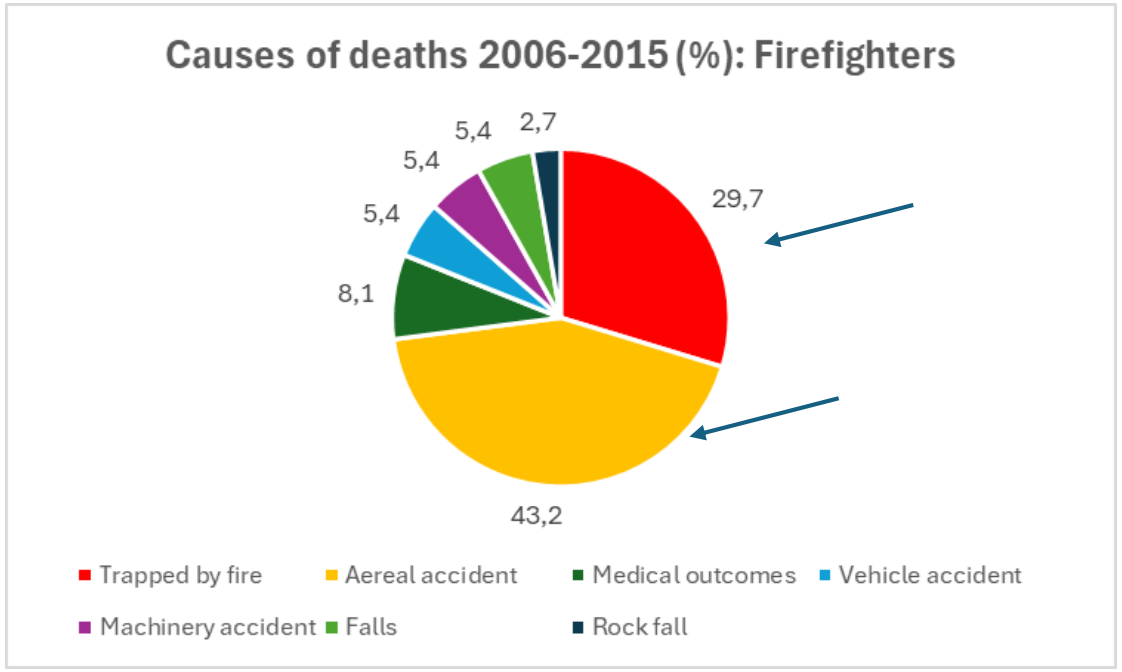
Evacuees 2006-2015 per Autonomous Region

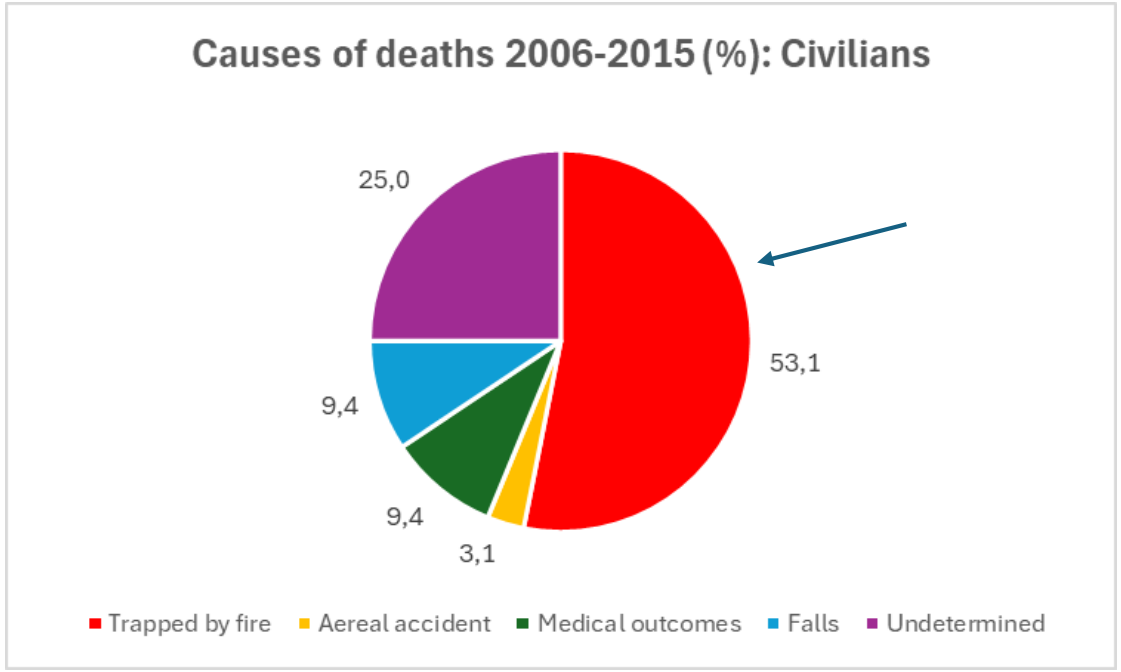


Data from EGIF


Fatalities
70
60
50
40
30
20
10
0
62
15
37
32
Firefighters
Civilians
1996-2005
2006-2015

Data from EG


Causes of deaths 2006-2015 (%): Firefighters
29,7
43,2
8,1
5,4
5,4
5,4
2,7
Trapped by fire
Aereal accident
Medical outcomes
Vehicle accident
Machinery accident
Falls
Rock fall


Causes of deaths 2006-2015 (%): Civilians
53,1
3,1
9,4
9,4
25,0
Trapped by fire
Aereal accident
Medical outcomes
Falls
Undetermined

Data from EG

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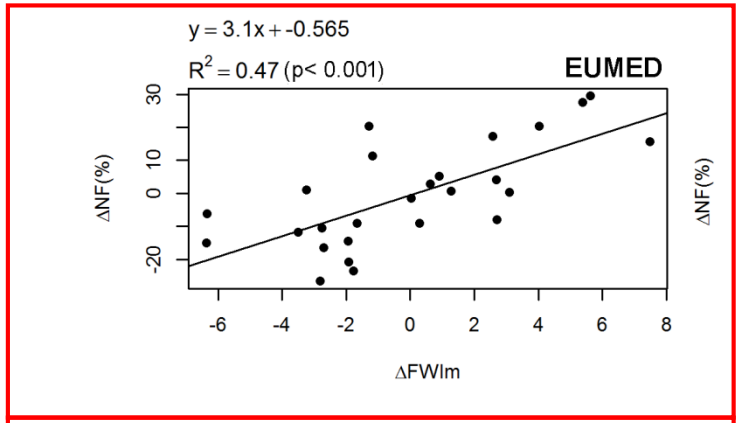
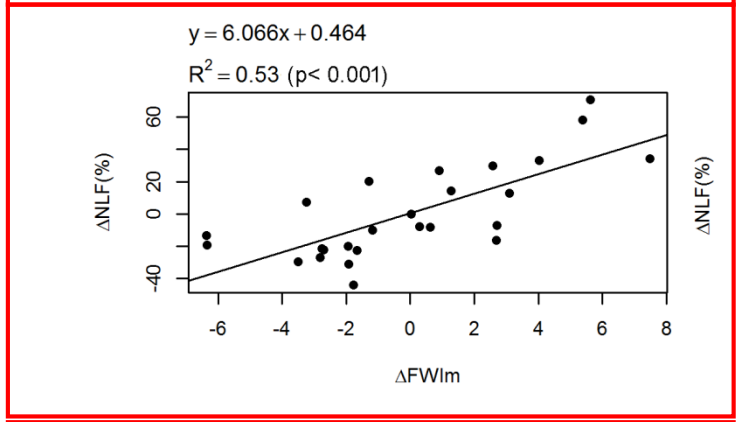
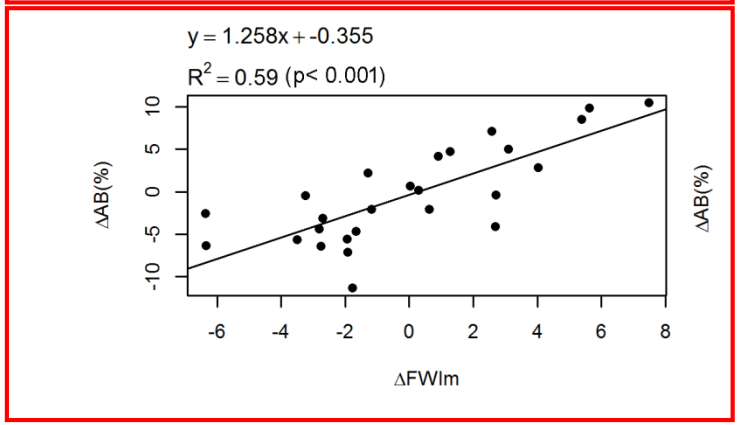
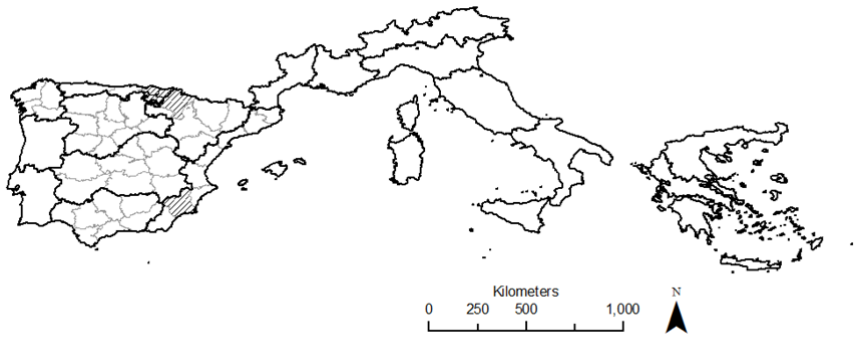
Fires and FWI in Europe

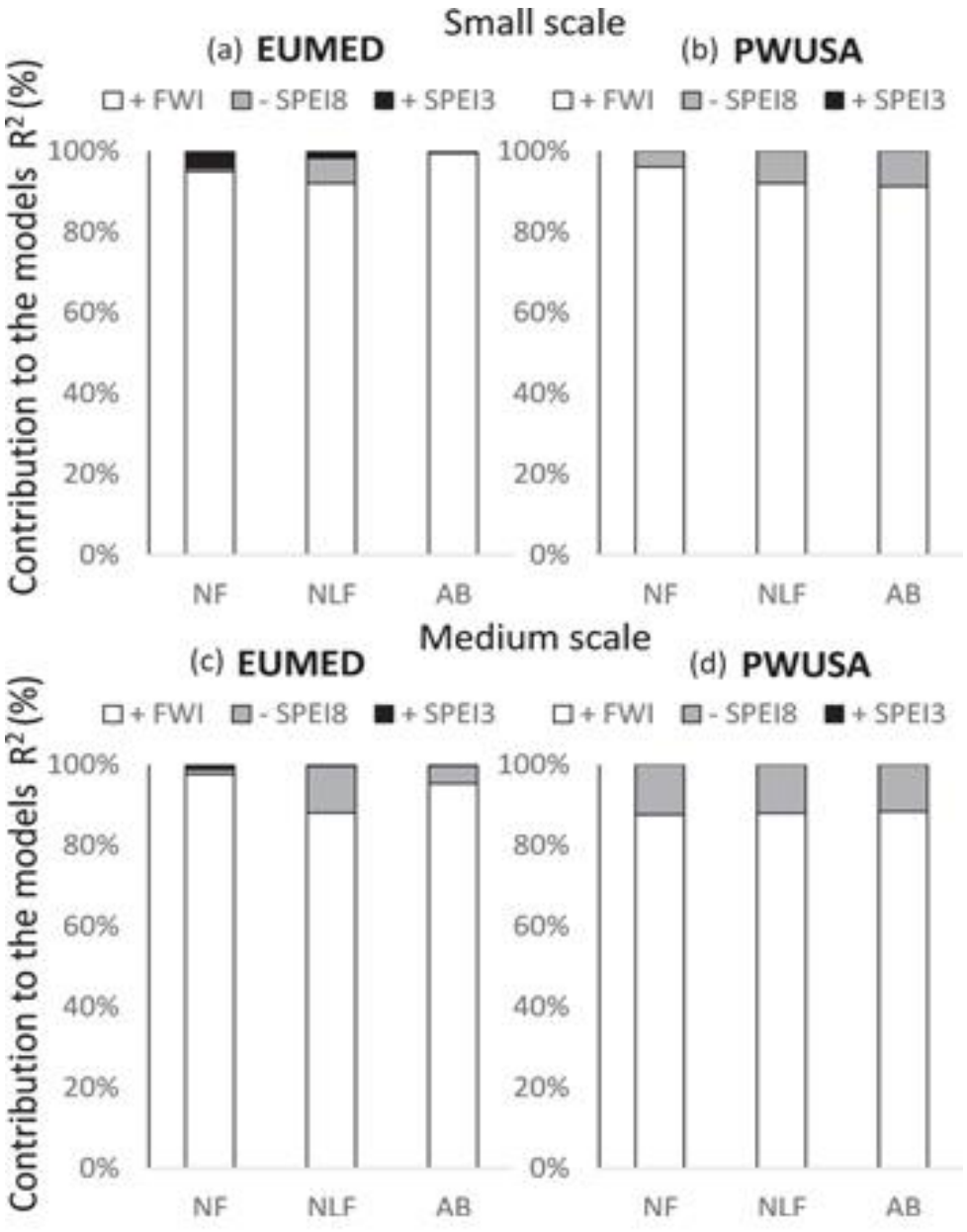








From Urbieta et al. 2015



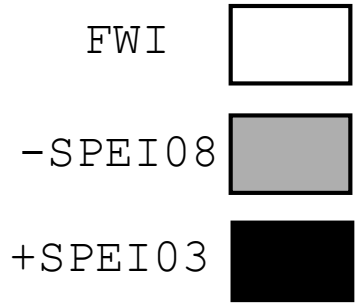
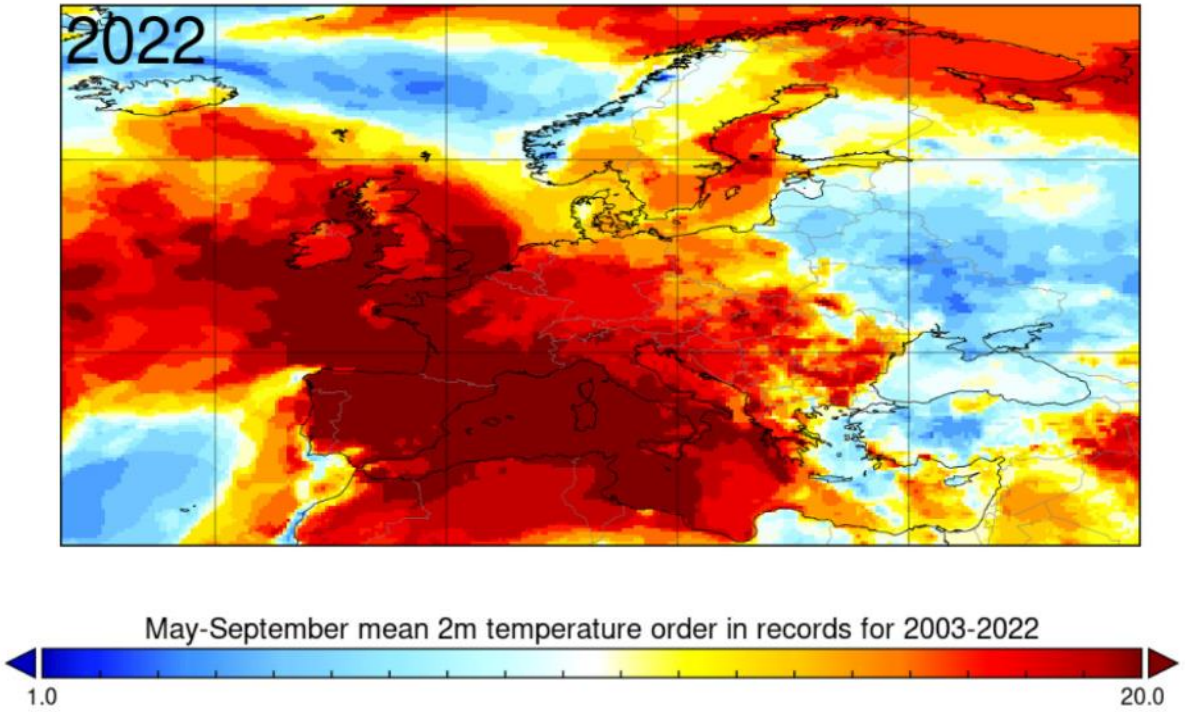
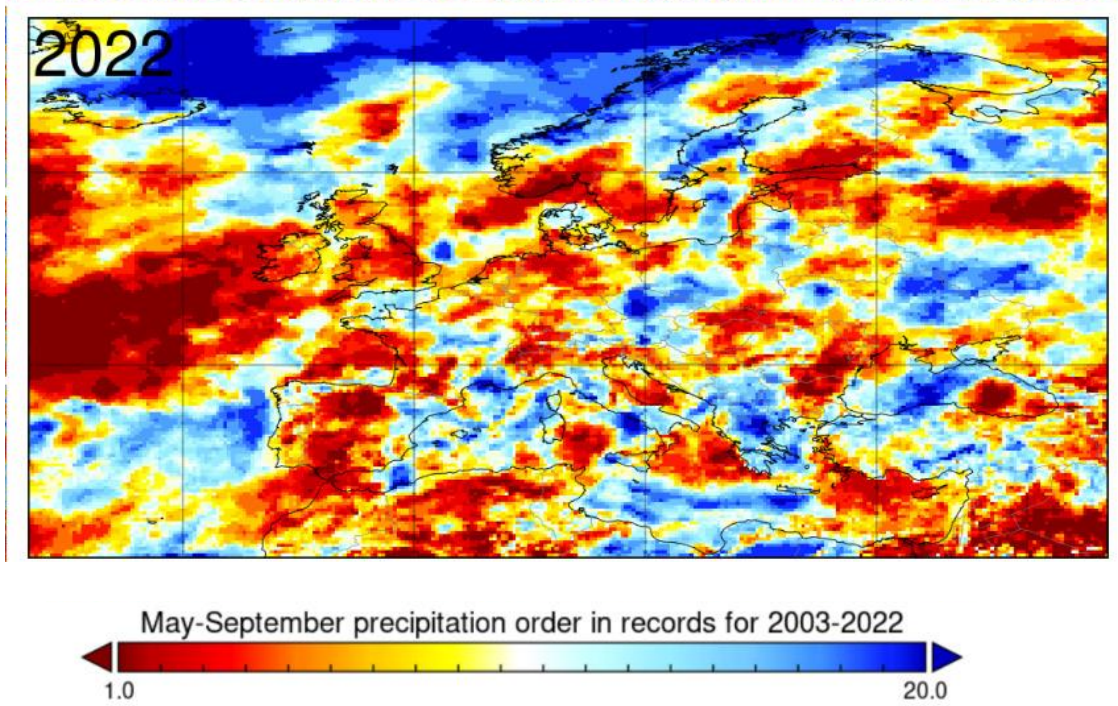


Figure 4 from Fire activity as a function of fire-weather seasonal severity and antecedent climate across spatial scales in southern Europe and Pacific western USA
Urbieta et al 2015 Environ. Res. Lett. 10 114013 doi:10.1088/1748-9326/10/11/114013

The extreme wildfire season of 2022
Temperature and precipitation



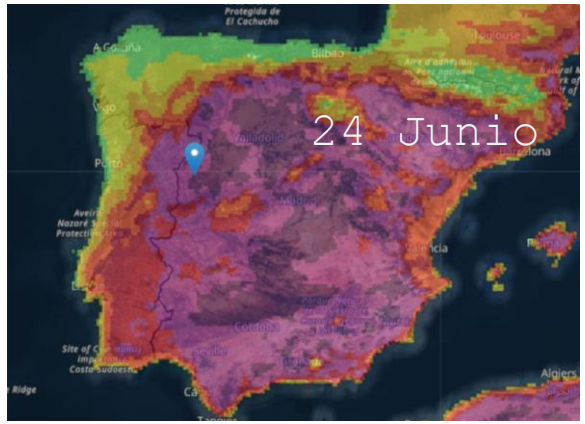
Value= 20: Hottest since 2003

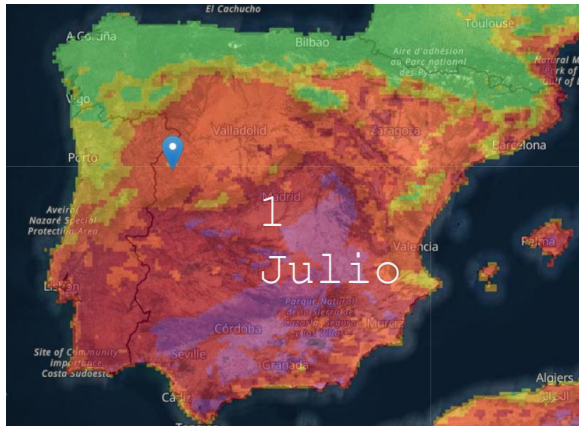


Value= 1: Driest since 2003

From EC, JRC et al. 20

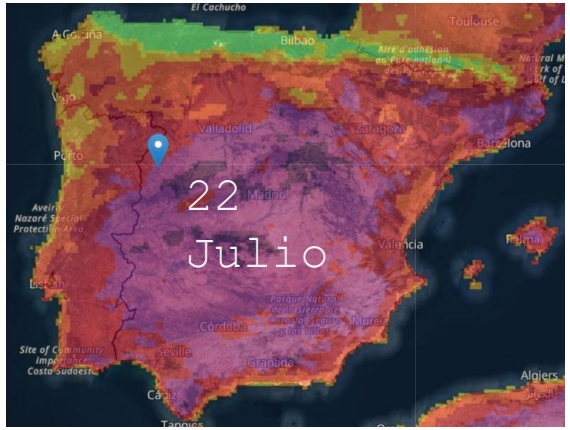
EFFIS FWI summer 2022

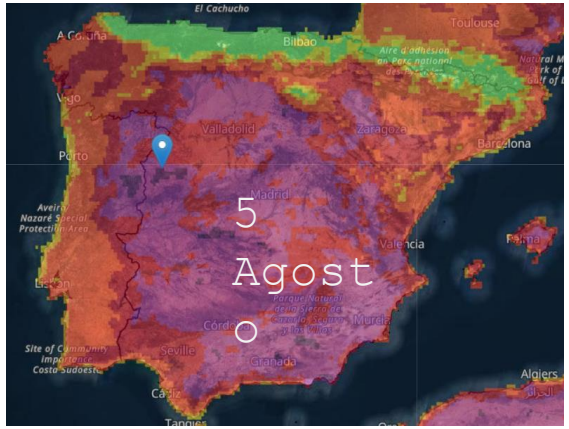


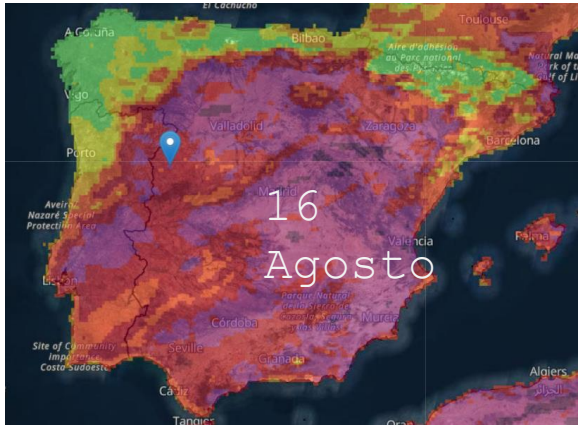


Fire Danger Forecast
(ECMWF/FWI)

- Very Low Danger
- Low Danger
- Moderate Danger
- High Danger
- Very High Danger
- Extreme Danger
- Very Extreme Danger







Fire Danger Classes	FWI
Very Low	FWI < 5.2
Low	5.2 >= FWI < 11.2
Moderate	11.2 >= FWI < 21.3
High	21.3 >= FWI < 38.0
Very High	38.0 >= FWI < 50.0
Extreme	FWI >=50.0

Data from EFFIS,

Fire danger indices and megafires risk

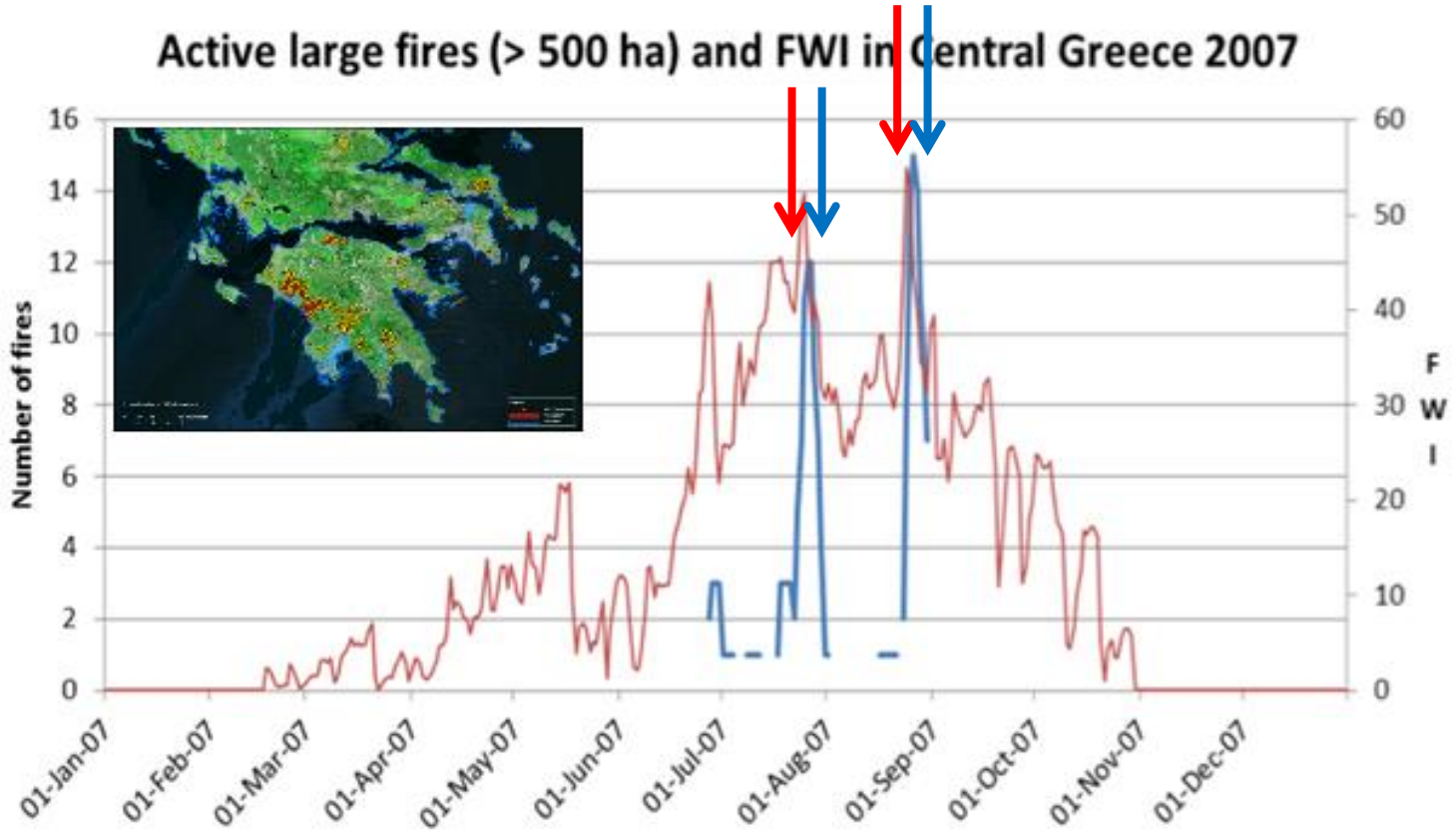
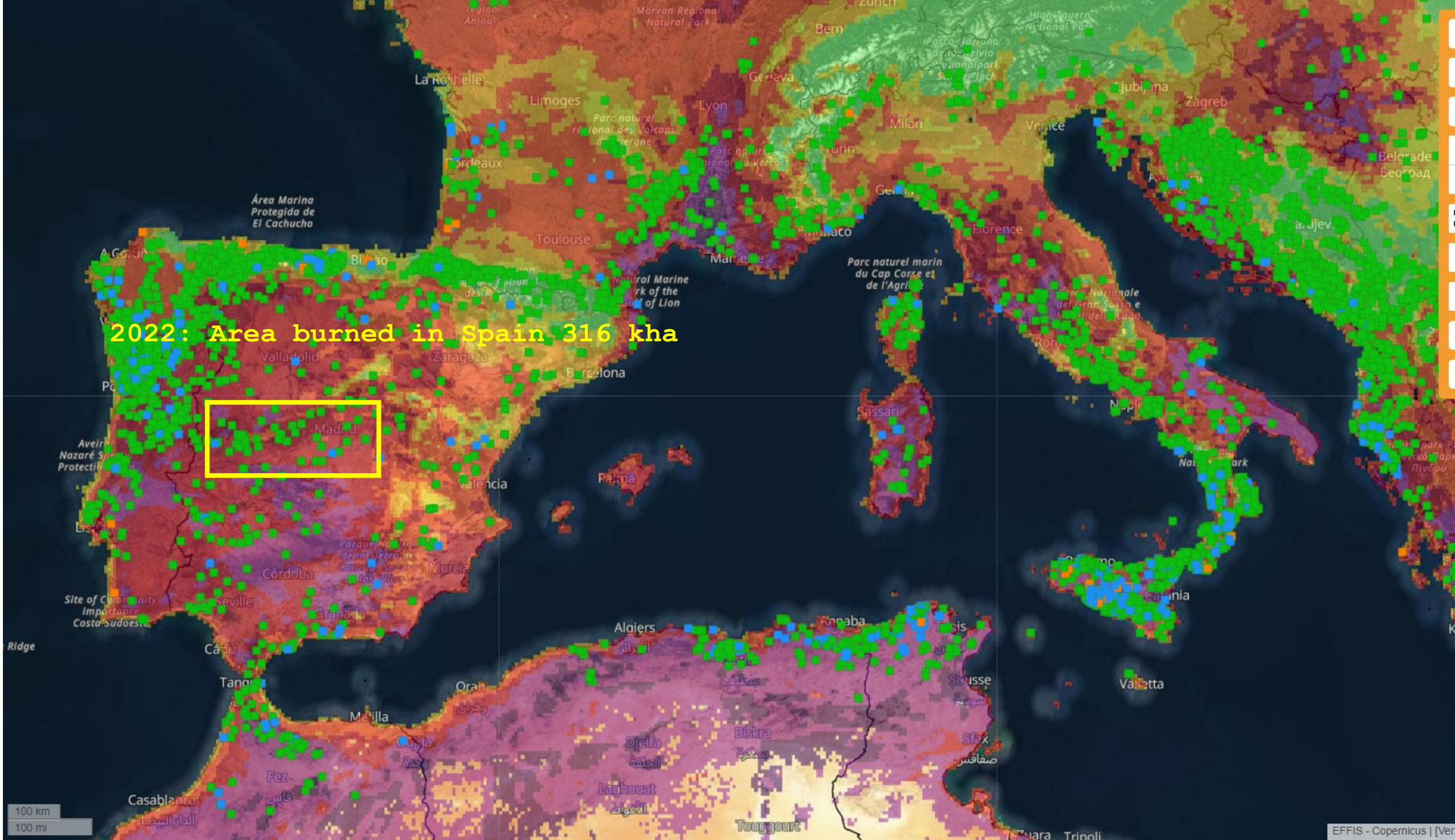
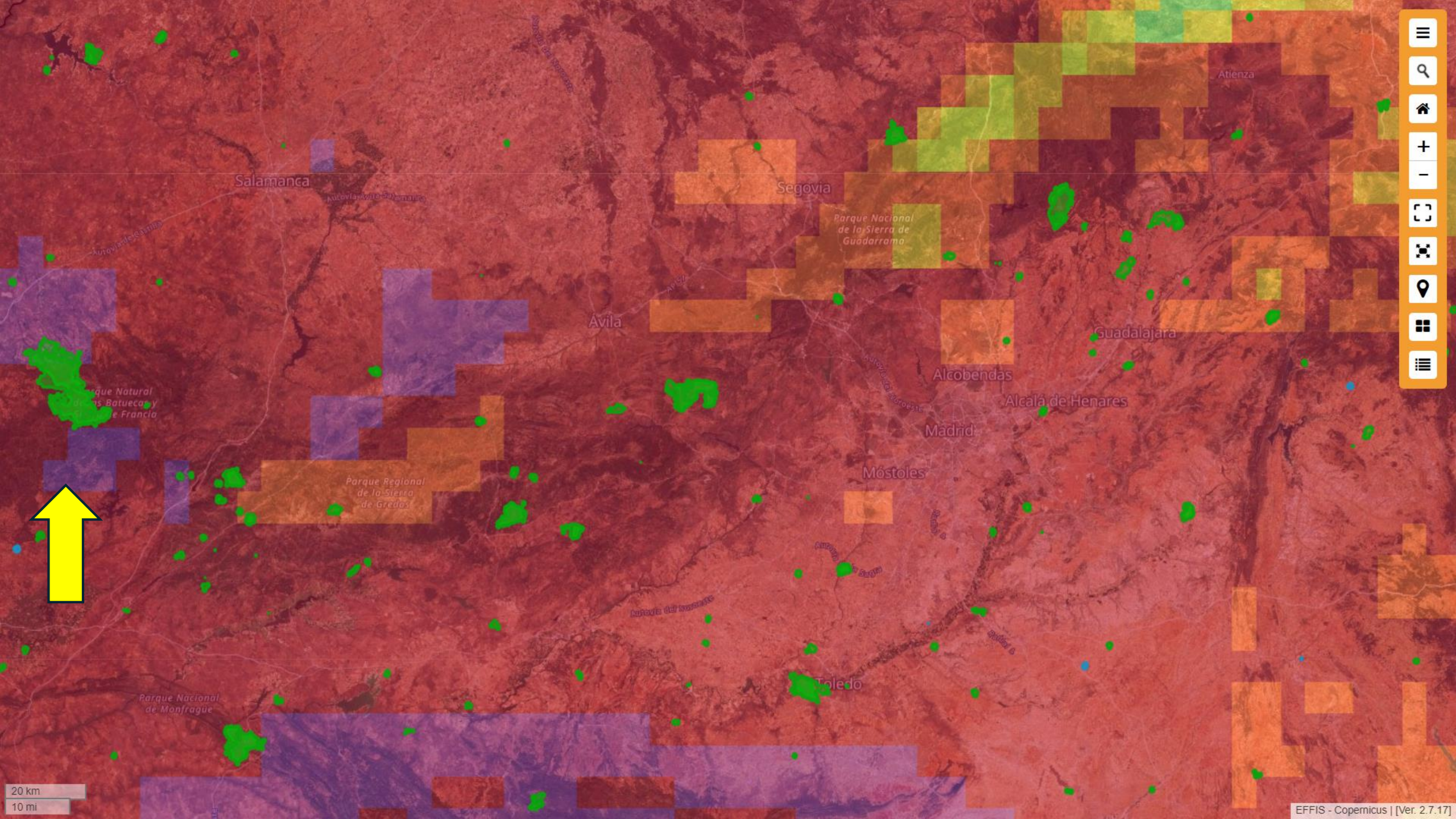


Fig. 11. Number of very large fires (>500 ha) and the fire danger index FWI in Greece, during the megafire event of 2007.

From San Miguel, Moreno and Camia 2013 FORECO

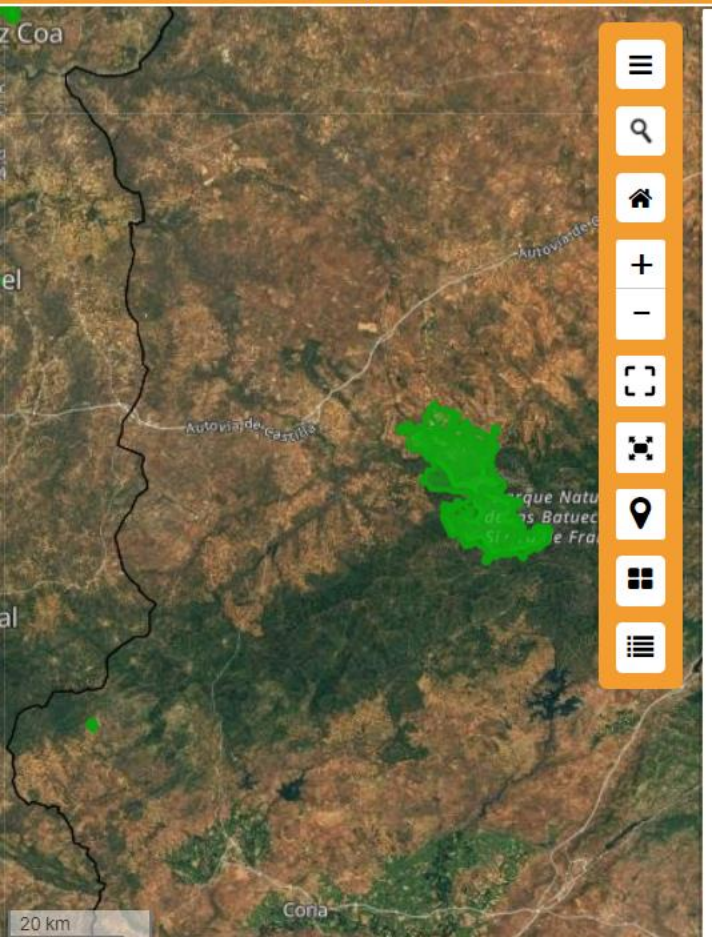

2022: Area burned in Spain 316 kha
Área Marina Protegida de El Cachucho
Parc naturel marin du Cap Corse et de l'Agriate
Natural Marine Park of the Gulf of Lion
Parque Natural de la Sierra de Cazorla, Segura y las Villas
Site of Community Importance Costa Sudoeste
Ridge
La Rochelle
Limoges
Bordeaux
Toulouse
Lyon
Geneva
Bern
Milan
Venice
Florence
Ljubljana
Zagreb
Belgrade
Београд
Sarajevo
Bilbao
Valladolid
Zaragoza
Barcelona
Madrid
Valencia
Palma
Sassari
Córdoba
Seville
Granada
Murcia
Cádiz
Tangier
Oran
Algiers
Annaba
Tunis
Sousse
Sfax
Djelfa
Biskra
Laghouat
Ouargla
Tougourt
Fez
Casablanca
Melilla
Valletta
Tripoli
100 km
100 mi
EFFIS - Copernicus | [Ver


Salamanca
Segovia
Avila
Atienza
Guadalajara
Alcobendas
Alcalá de Henares
Madrid
Móstoles
Toledo
Parque Nacional de la Sierra de Guadarrama
Parque Regional de la Sierra de Gredos
Parque Nacional de Monfragüe
20 km
10 mi
EFFIS - Copernicus | [Ver. 2.7.17]

COPERNICUS

Emergency Management Service

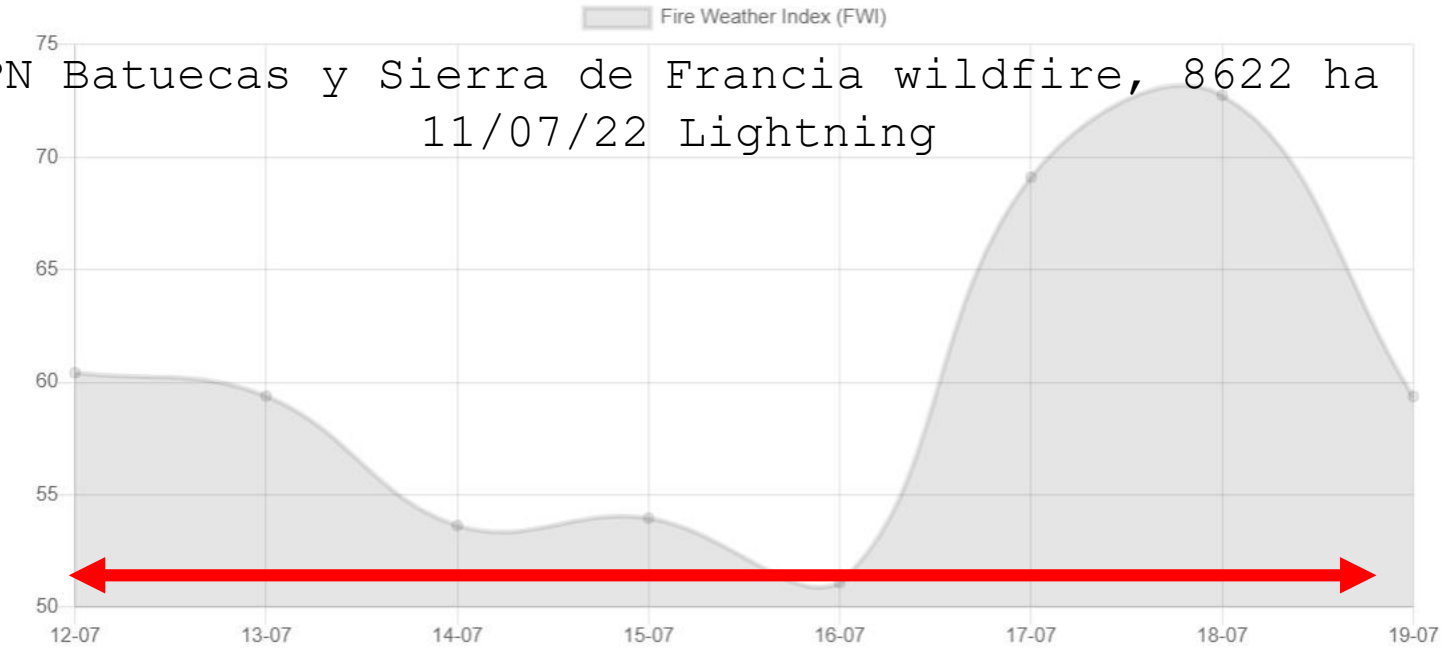
European Commission > JRC EU Science Hub > DRM > Copernicus EMS > EFFIS > Applications > Current Situation Viewer [user guide]



Coordinates [lat-lng]: [39.709860869253056--5.754804938182754]

Source: :ECMWF (8 km res.)

- Fire Weather Index (FWI)
- Initial Spread Index (ISI)
- Build Up Index (BUI)
- Fine Fuel Moisture Code (FFMC)
- Duff Moisture Code (DMC)
- Drought Code (DC)
- Anomaly
- Ranking



PN Batuecas y Sierra de Francia wildfire, 8622 ha
11/07/22 Lightning

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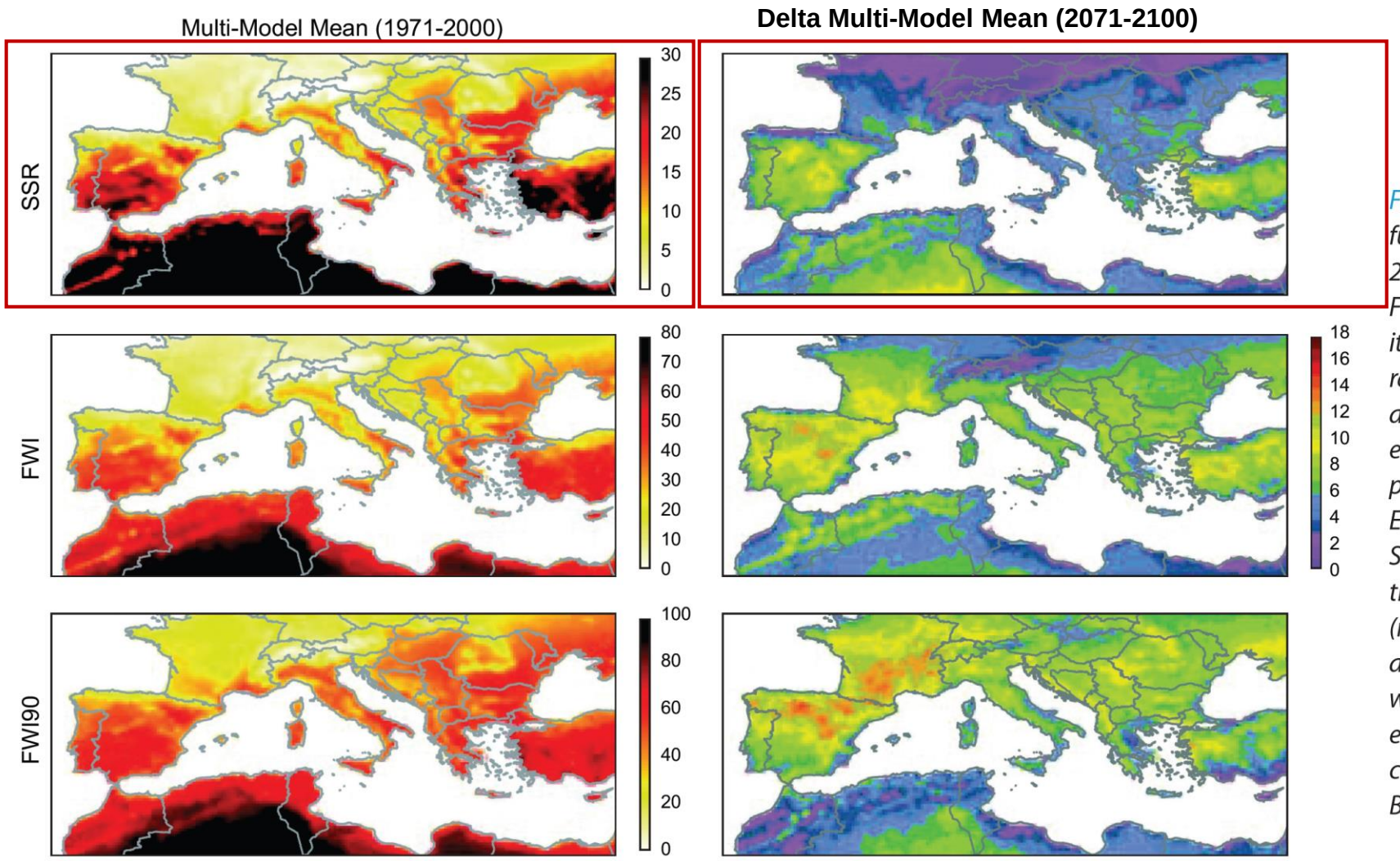
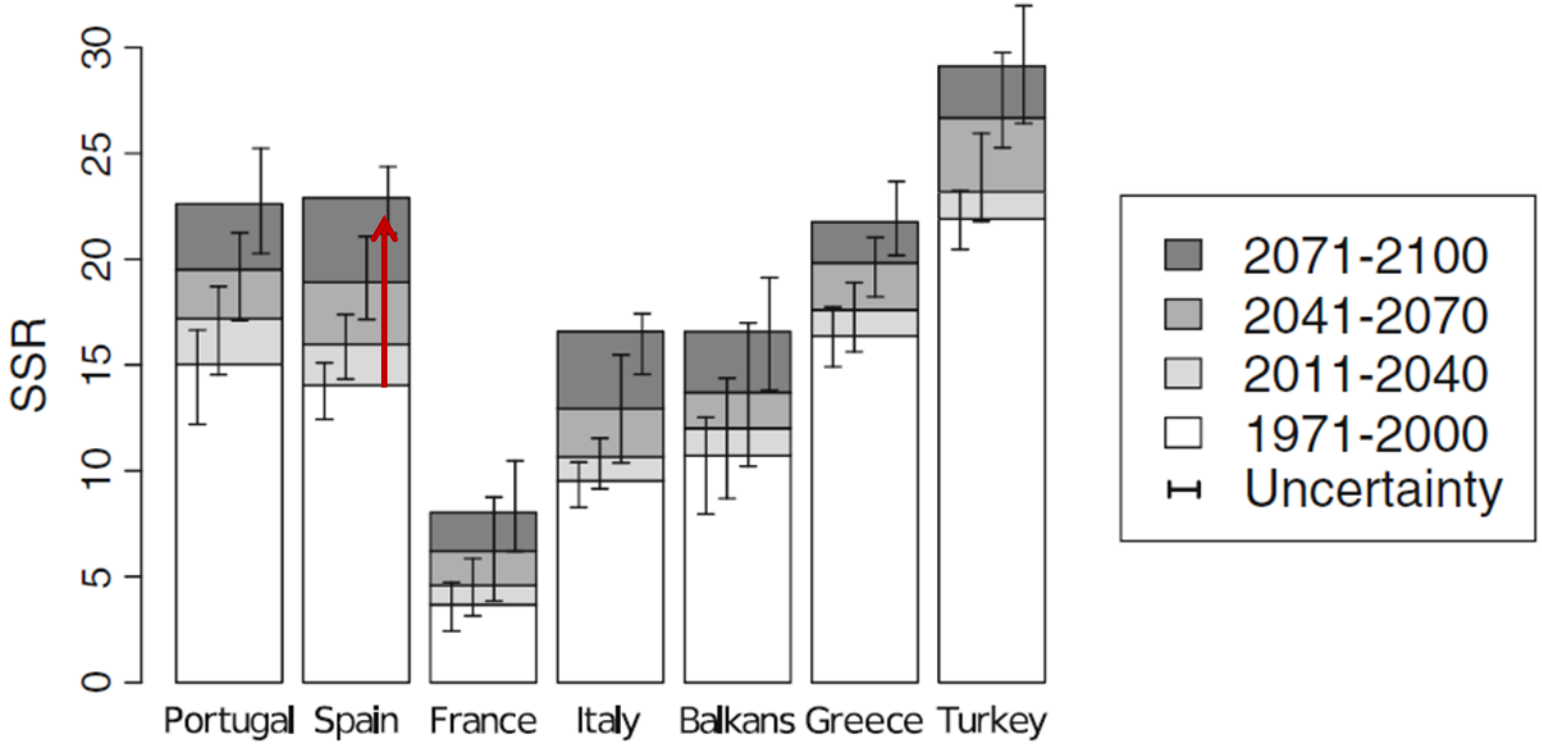


Fig: 11.2: Control (1971–2000) and future projections (deltas, 2071–2100) of FWI, 90th percentile of FWI (FWI90) and seasonal severity rating (SSR) for the Mediterranean for the period 2071–2100 according to the multi-model ensemble of five RCM-GCM couplings from the EU-funded project ENSEMBLES, corresponding to the SRES A1B emissions scenario for the fire season (JJAS). Delta values (right panels) are calculated as the anomalies of the future scenario with regard to the multi-model ensemble mean of the current climate values (left panel). From Bedia et al., 2014.

De Bedia et al 2013 Climatic Change

Seasonal Severity Rating in 21st century



Change in mean Seasonal Severity Rating based on 5 regional models and SRES A1B during the 21st century

From Bedia et al. Climatic Change 2013

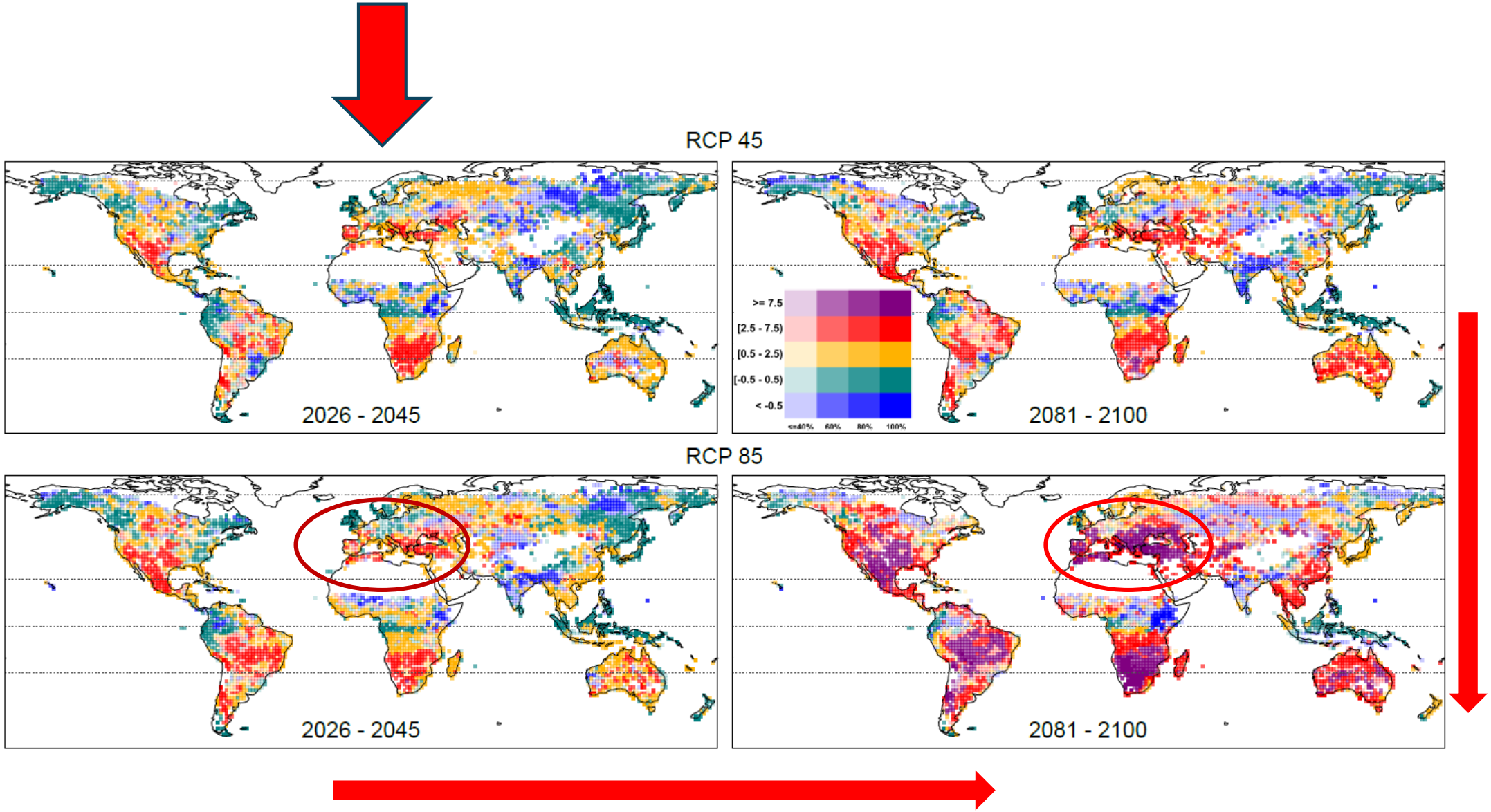
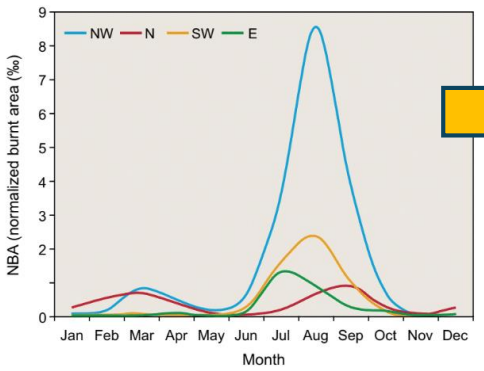
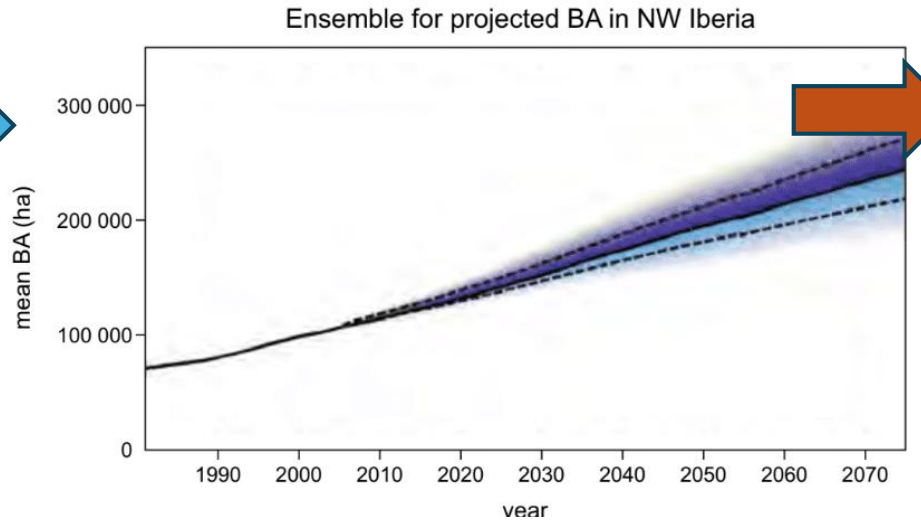


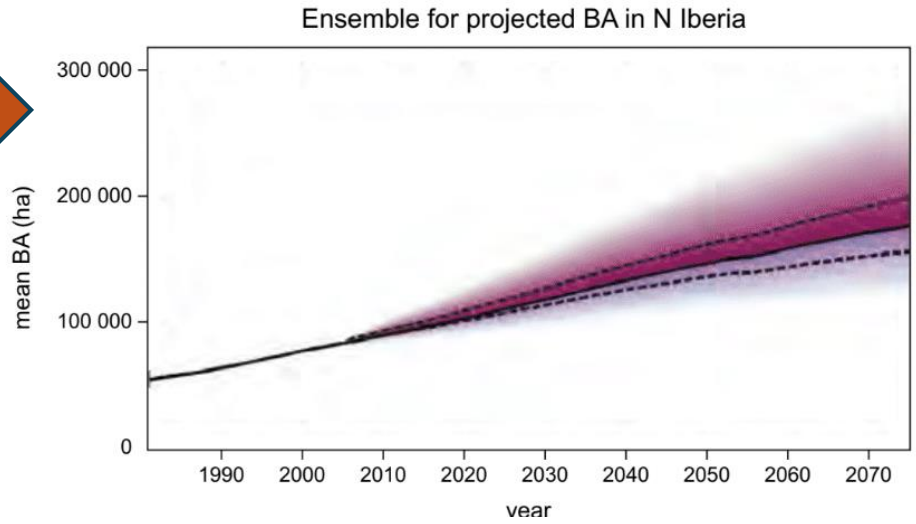
Fig. 4. Projected FWI anomalies by the multi–ESM ensemble for the two future periods (2026–2045 and 2081–2100) according to RCPs 45 and 85. Colour tones indicate the magnitude (and direction) of the anomalies and colour intensities the multi-model agreement.

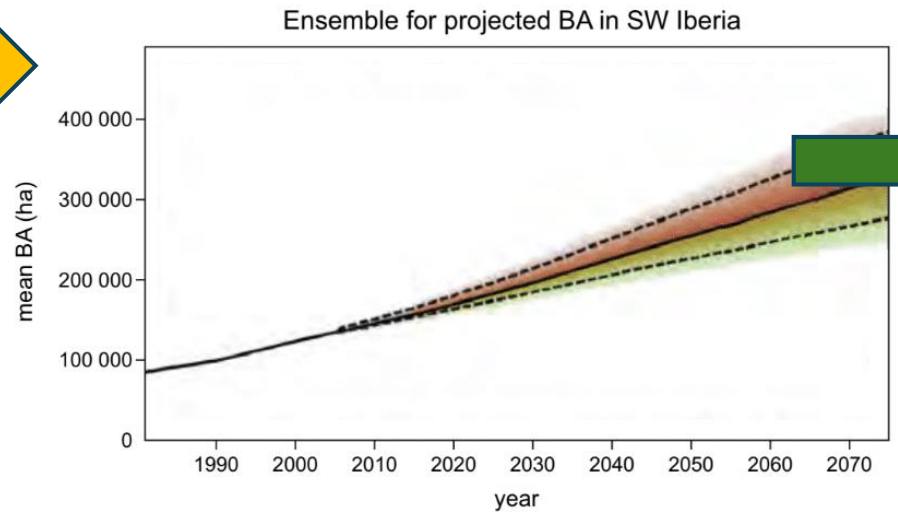
De Bedia et al. 2015 Agric. For Met

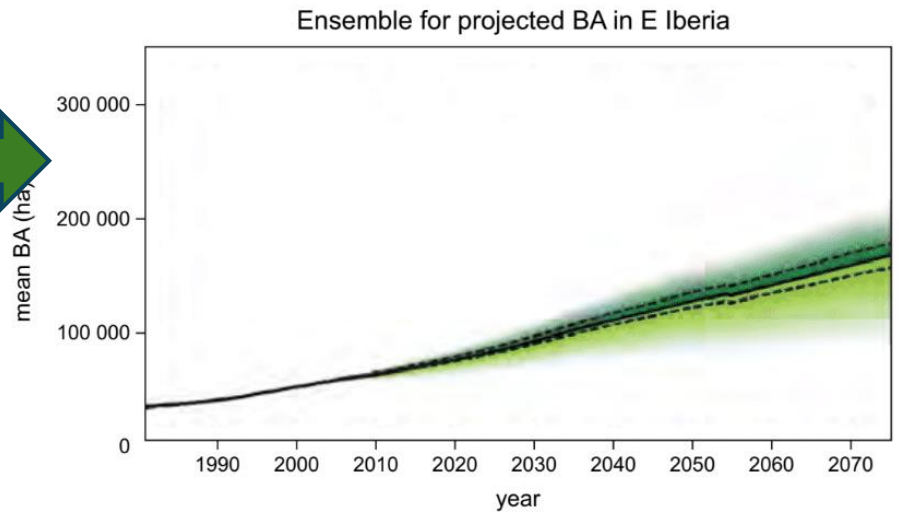
Future fires in Iberia







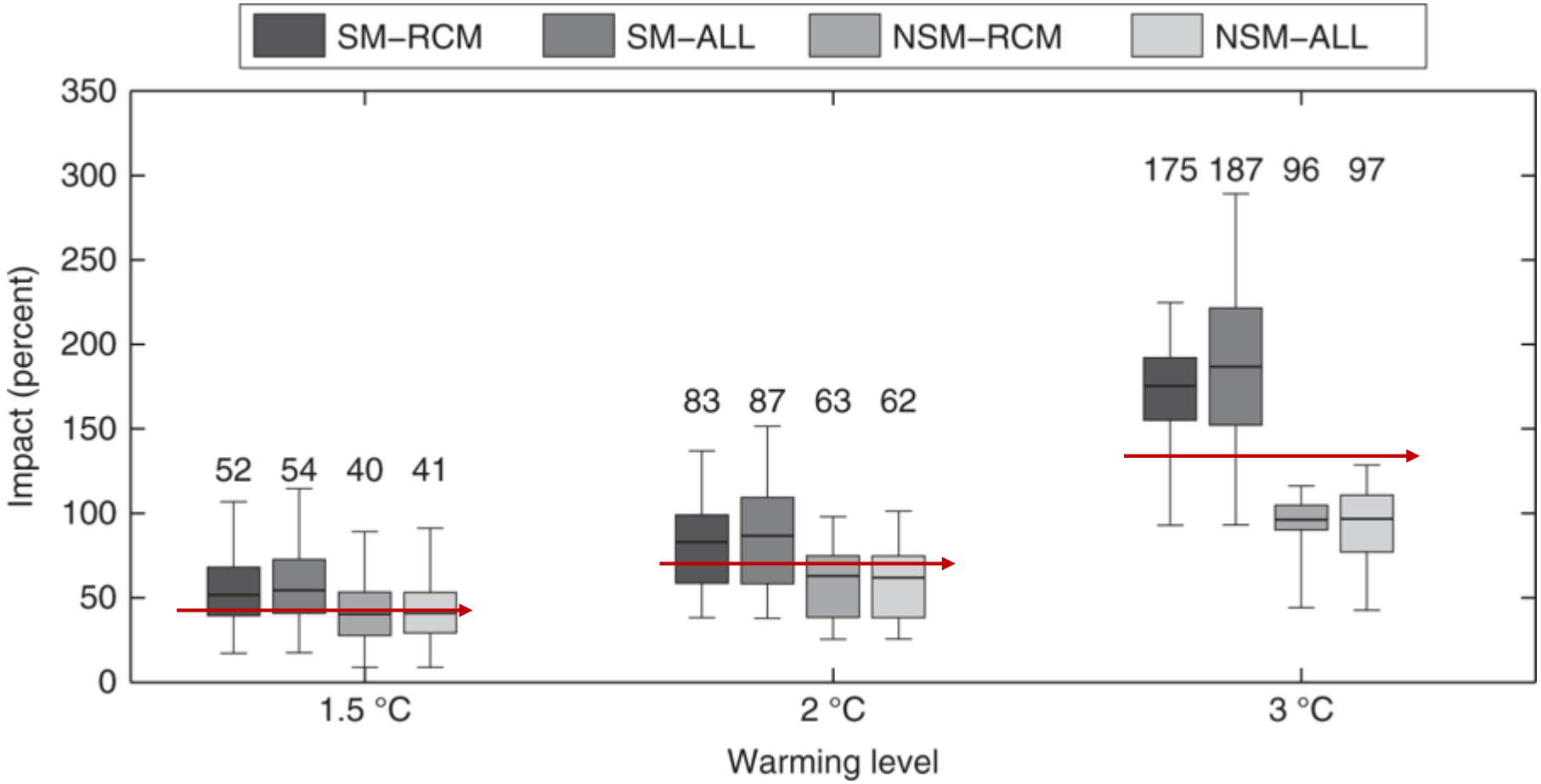




Ensembles of projected mean burned area (BA) for the period 1981-2075 in the four Iberian clusters. The solid line represents the mean of all 16 considered simulations. The upper dashed line represents the mean of the simulations that use fixed reference climatology, while the lower dashed line represents the mean of the simulations using moving reference climatology. Darker and lighter shades represent ensemble uncertainties of the previous simulations and were obtained using inter-quartiles. A 25-year moving average was applied to all series.

Source: Trigo et al. 201

Future fires in the Mediterranean



Future area burned (% change) in EUMED using SPEI index with increasing level of global warming based on stationary (SM) or non-stationary (NSM) models and a suite of future climate simulations (RCM, ALL). From Turco et al. 2018.

Content

- Current trends of wildfires and their drivers
- Wildfires with Civil Protection incidence
- Wildfires and climate relationships
- Projections under climate change
- Conclusions

Conclusions

- Despite increased forest land and severe climate, wildfires have been decreasing due to the high firefighting capacity implemented
- Wildfires threaten urban areas, and many people are evacuated every summer due to fires
- Ongoing climate change will cause larger and more intense fires, and continue threatening urban areas
- Extreme wildfire seasons will further challenge these capacities and can overwhelm them (e.g., 2022)
- A change in policy aimed at managing landscapes and reducing fuels is needed, particularly at the WUI

The Montesión wildfire, July 2020, in the outskirts of of Toledo, Spain

Thank you!