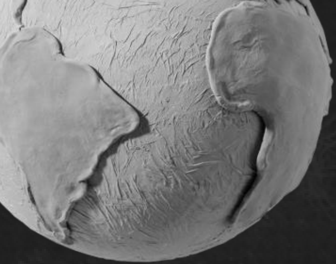
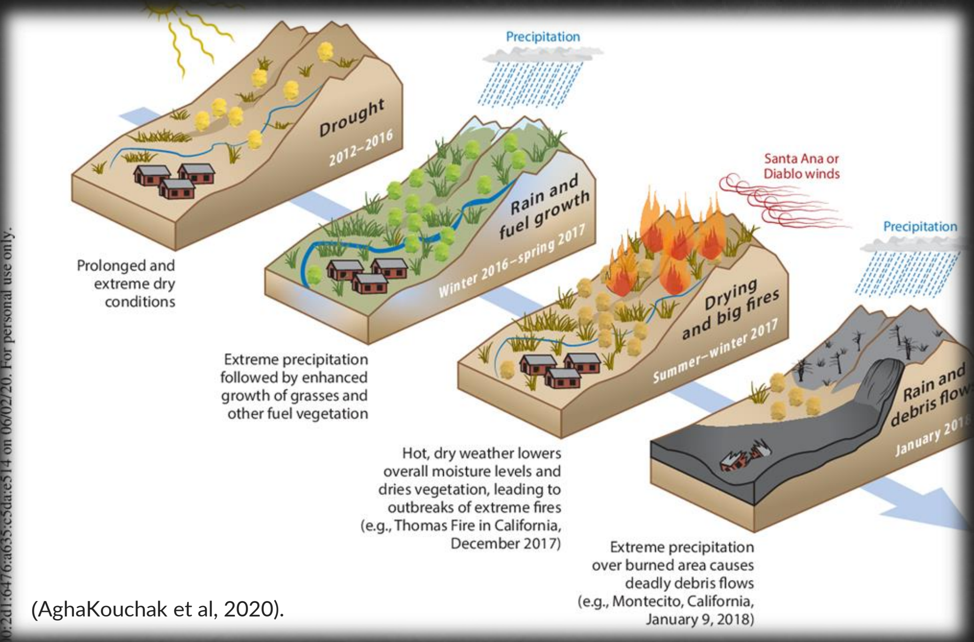


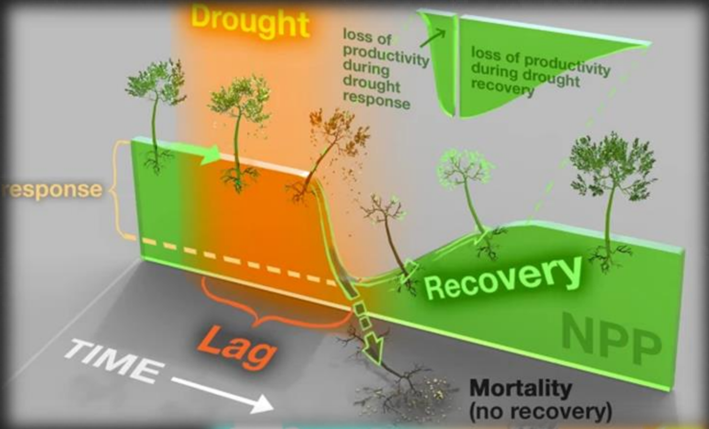
Droughts, heatwaves, and fires: compound and cascading hazards and their impacts on vegetation dynamics

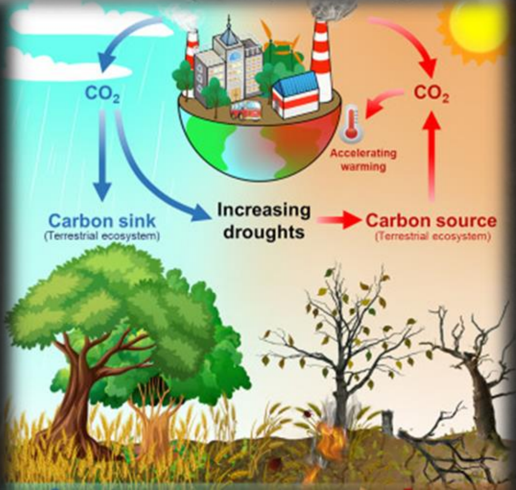
Célia Gouveia
celia.gouveia@ipma.pt
cmgouveia@fc.ul.pt

01 The Problem



(AghaKouchak et al, 2020).





Heatwave, Drought and Fires

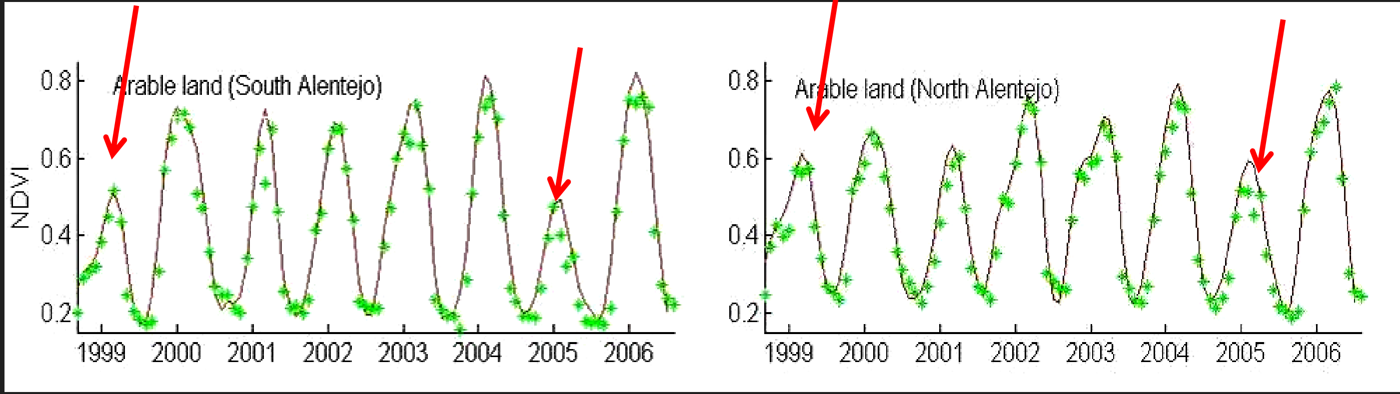
02

Droughts

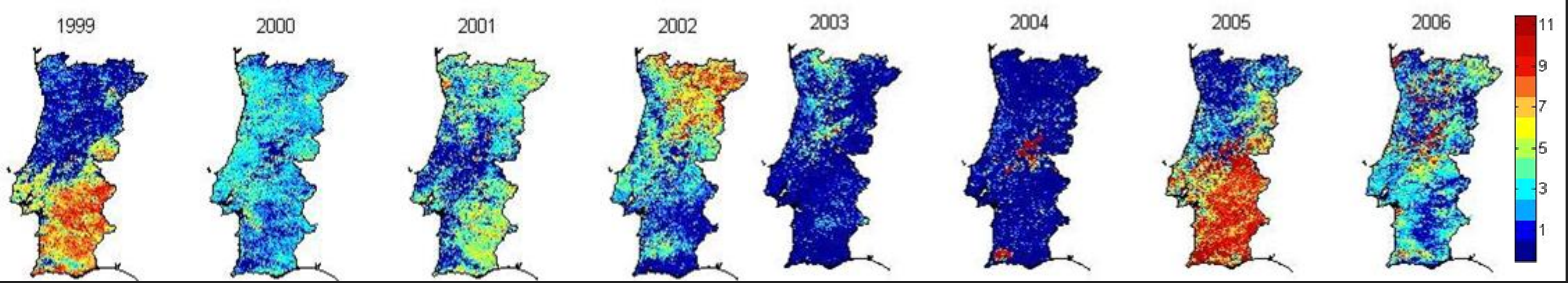
... vegetation and crops

02 Droughts

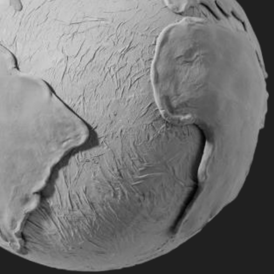
Monthly NDVI (SPOT/VEGETATION, 1999–2006)



Gouveia et al. (2009)

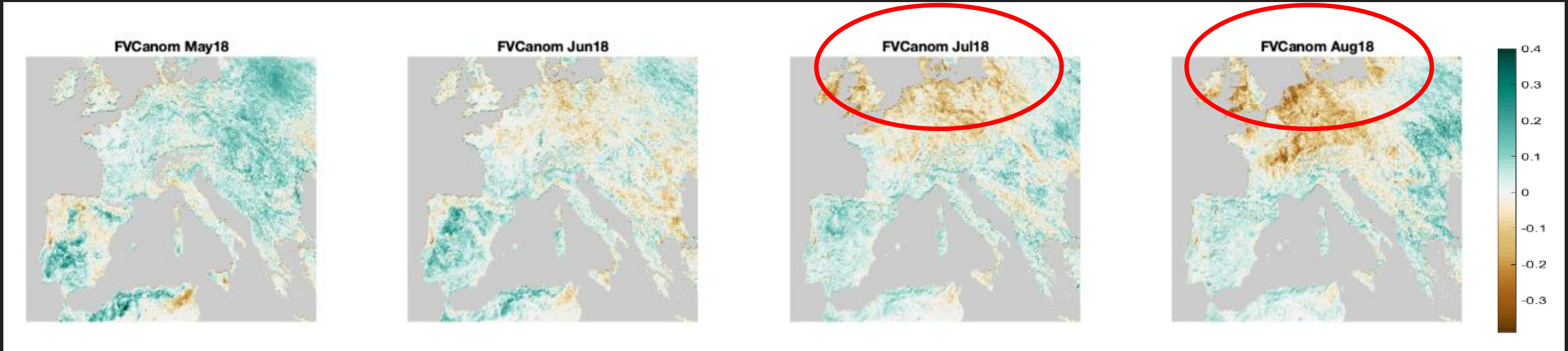


Drought persistence (the number of months with NDVI anomalies < -0.025).



02 Droughts

2018: hot and dry year over central Europa



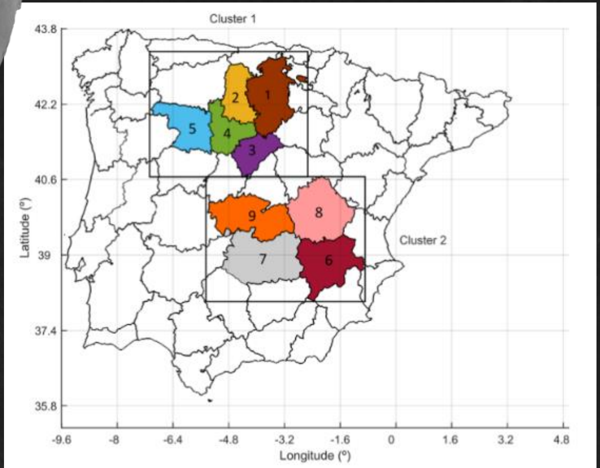
Climatology derived between 2004 and 2018 (using median)

FVC

MSG/SEVIRI

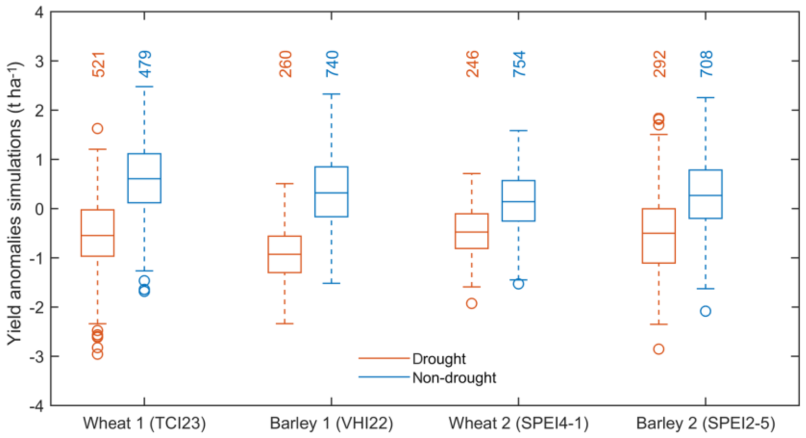
FVC Monthly anomalies

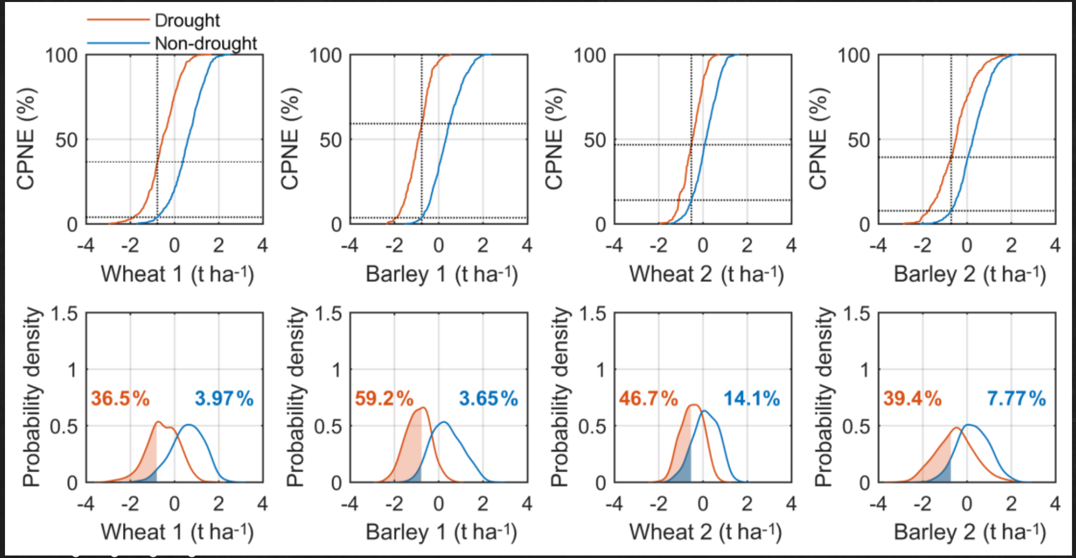
02 Droughts



2010

Cereal (X)	Drought indicator (Y)	Standardized regression coefficients
Wheat 1	TCI 23	0.76
Barley 1	VHI 22	0.91
Wheat 2	SPEI 4–1	1.05
Barley 2	SPEI 2–5	1.07





(Ribeiro et. al (2019a, 2019b)

03

Heatwave

... and carbon uptake

03 Heatwaves

LST – Land Surface Temperature
SEVIRI-MTG

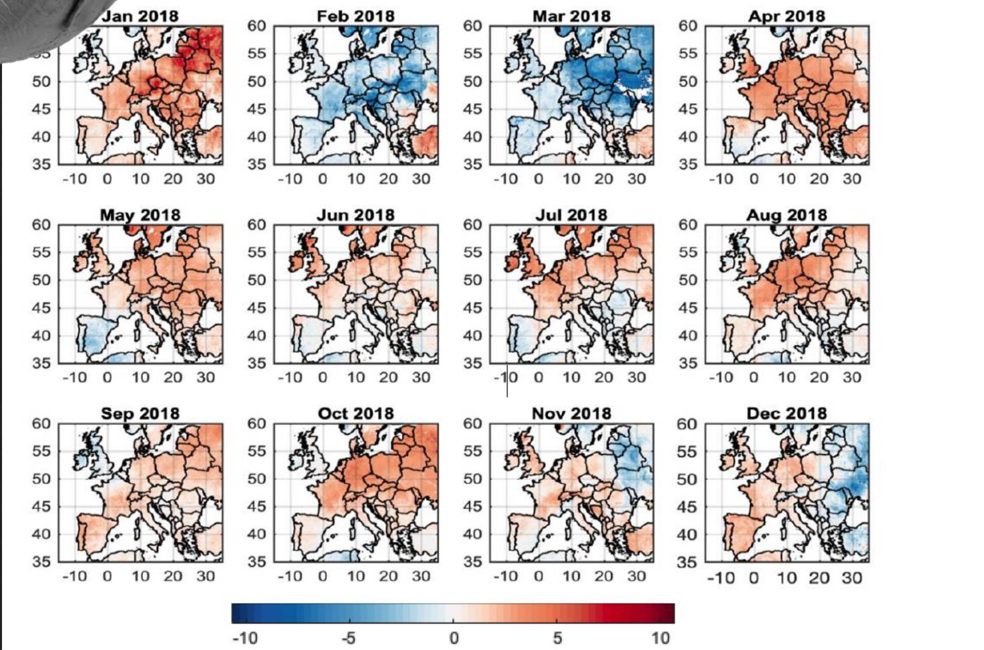


Figure 3. Monthly anomaly values of MSG LST during 2018 over Europe, with respect to 2004–2019.

(Gouveia et., al 2022)

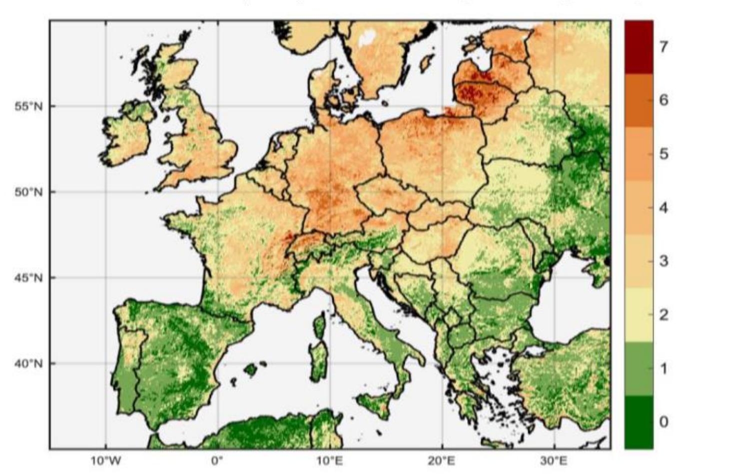
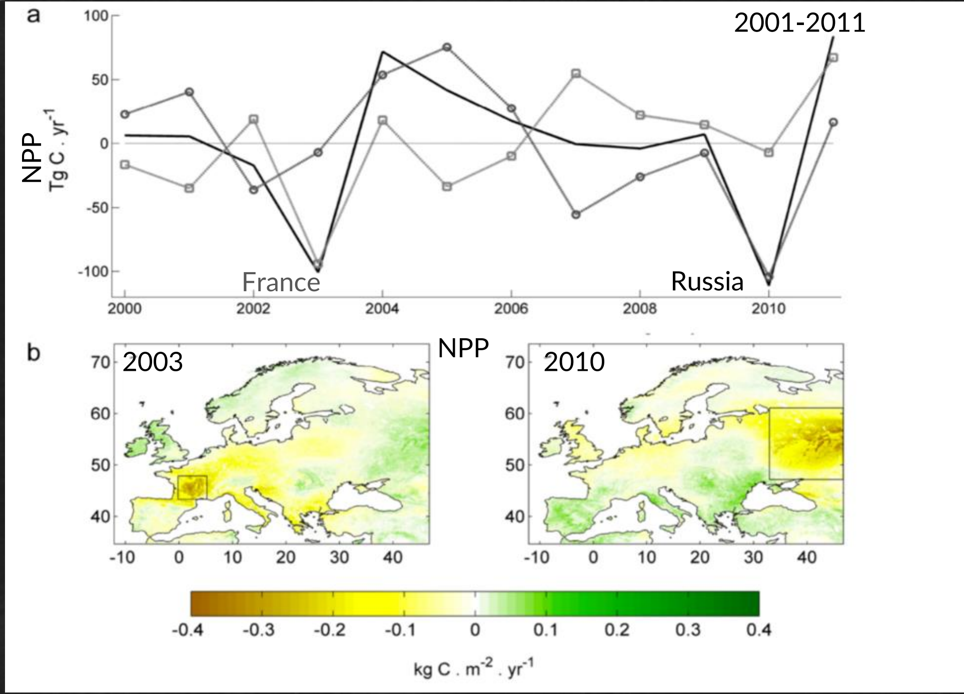
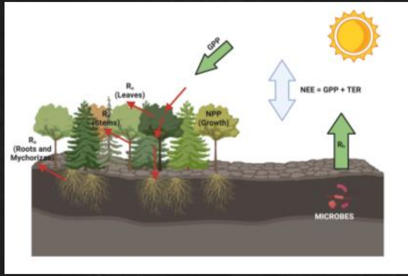


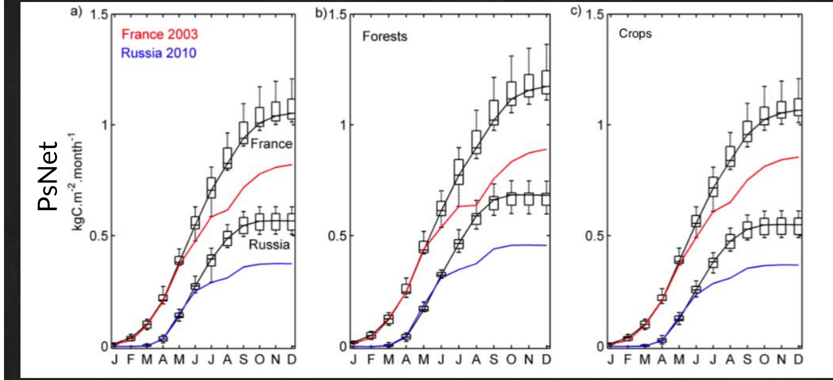
Figure 4. Spatial patterns of the number of months in 2018 which recorded the highest monthly MSG LST anomaly value regarding the 2004 to 2019 period.

03 Heatwaves

NPP, GPP, PsNet
MODIS





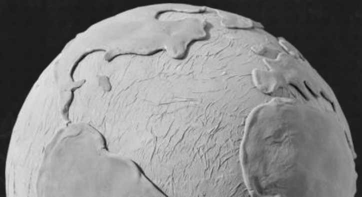


(Bastos et., al 2014)

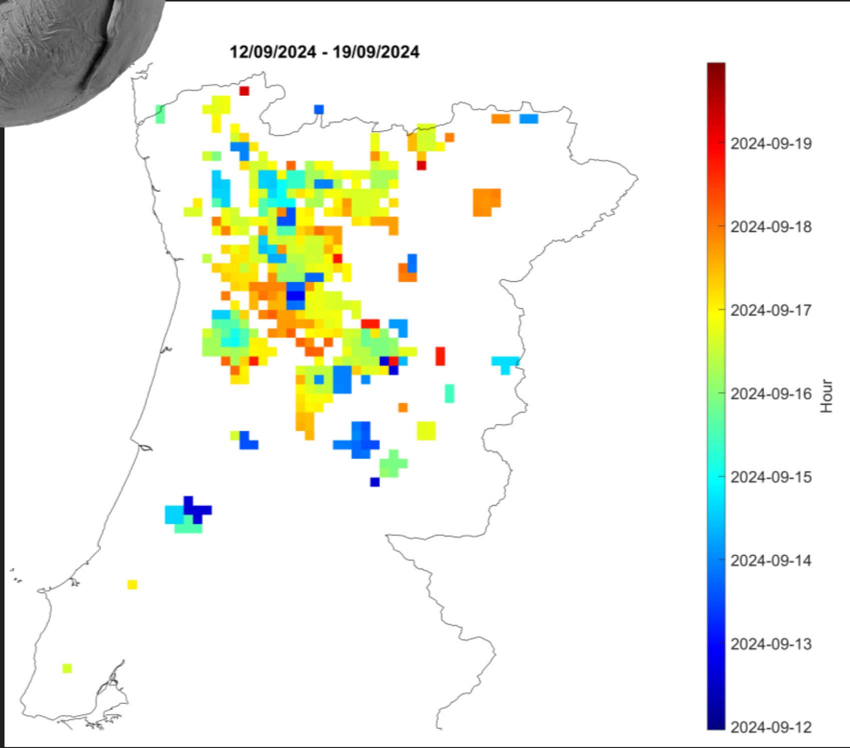
04

Fires

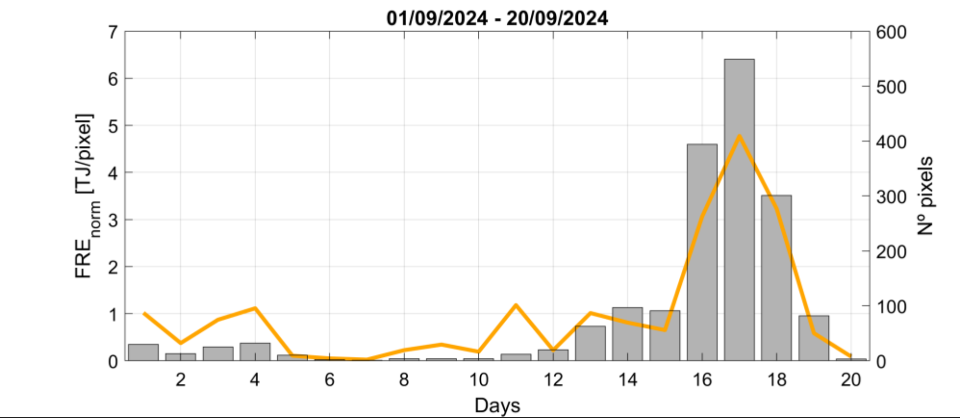
... and vegetation, carbon uptake and crops

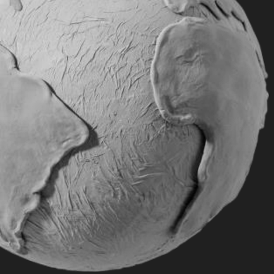


04 Fires



FRP
SEVIRI – MSG





04 Fires

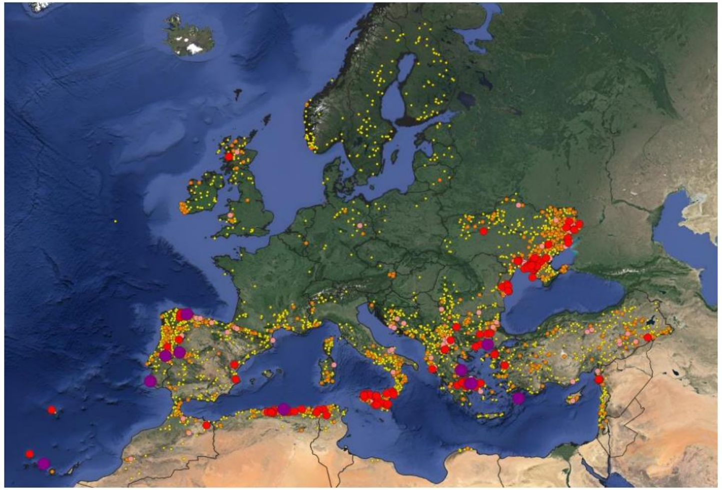
EU Science Hub

Home > JRC news and updates > Wildfires: 2023 among the worst in the EU in this century

NEWS ANNOUNCEMENT | 10 April 2024 | Joint Research Centre | 3 min read

Wildfires: 2023 among the worst in the EU in this century

A sharp increase in burnt areas was recorded during the summer months of 2023, mostly affecting the Mediterranean region. By total burnt surface area, 2023 was the fourth worst year since 2000.

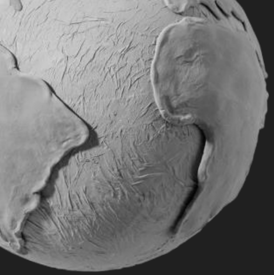


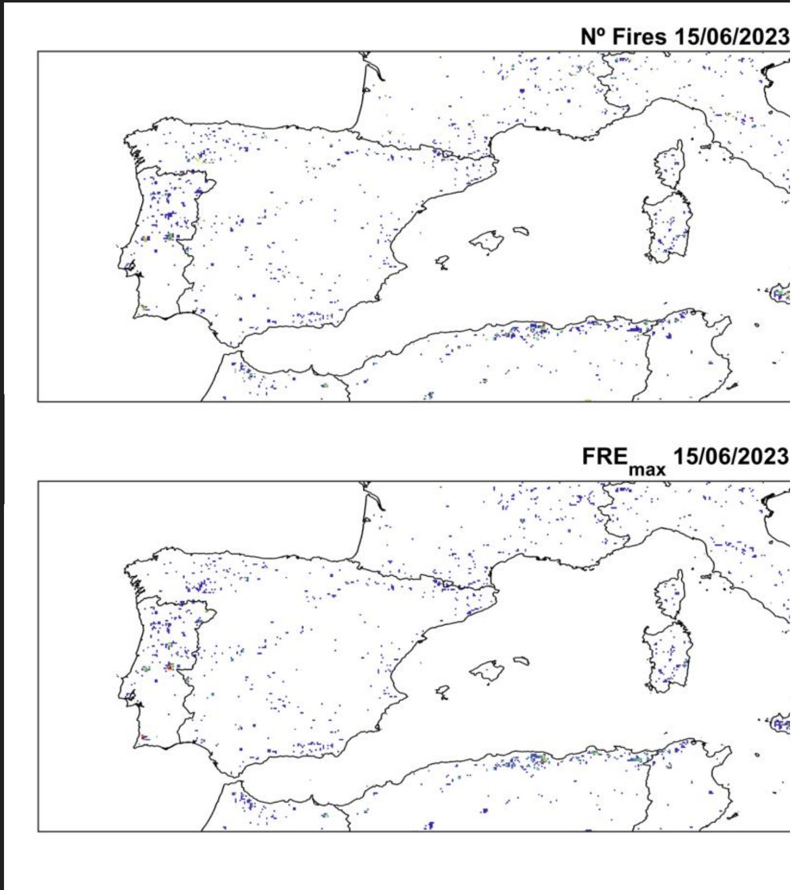
Extent of burnt areas in 2023 as reported by EFFIS. Yellow dots refer to areas up to 100 ha, orange up to 500 ha, pink up to 1000 ha, red up to 5000 ha, purple beyond 5000 ha.

The largest single fire ever to occur in Europe since the 1980s was recorded near Alexandroupoli (Greece)

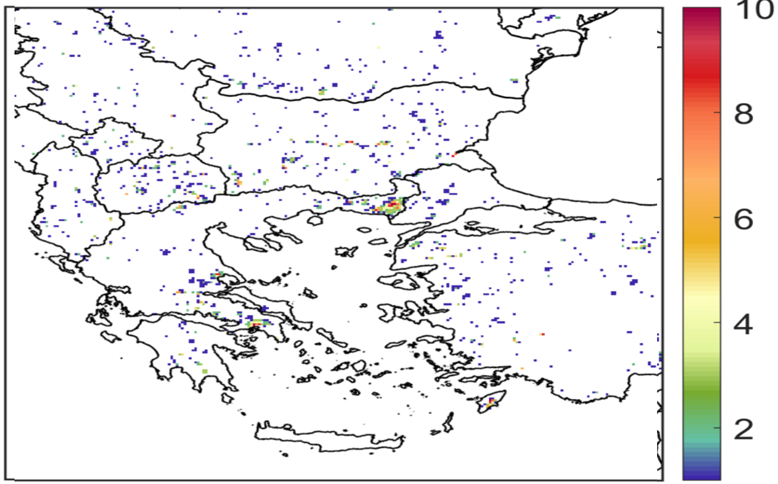
Ignited on 19 August resulted in a burnt area of over 96,000 ha and caused numerous human casualties.

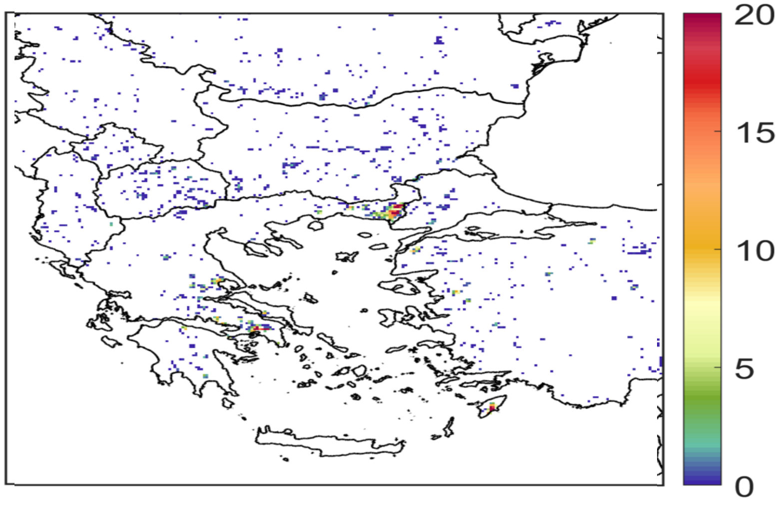
Advance report on Forest Fires in Europe, Middle East and North Africa 2023.



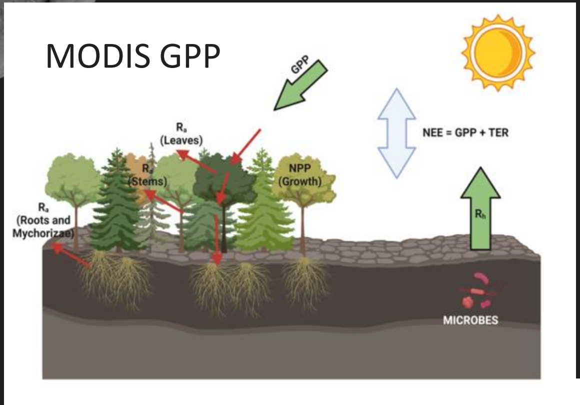


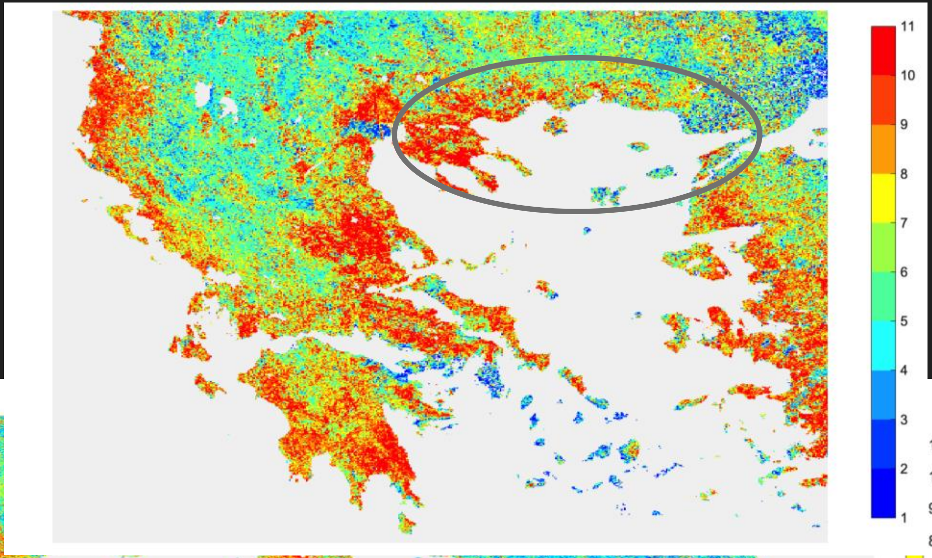
FRP
SEVIRI – MSG

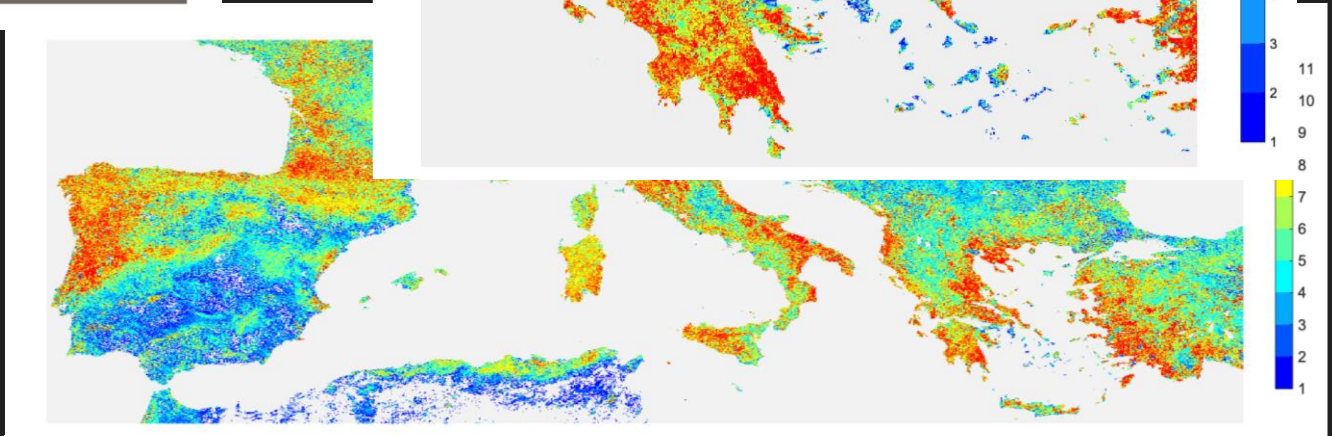




06 Droughts, Heatwaves and Fires







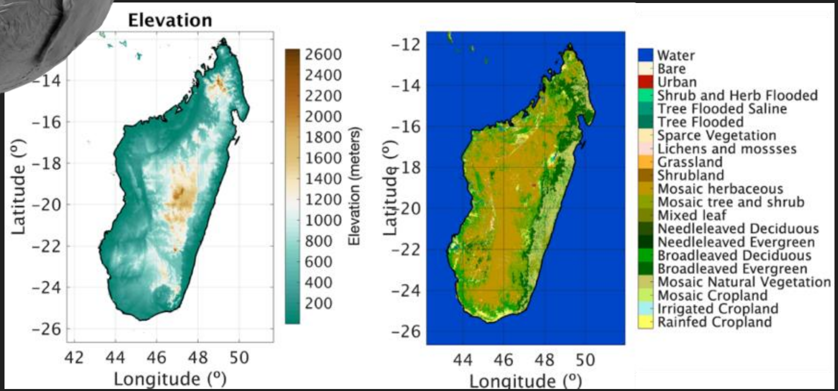
Number of bi-weekly periods with GPP > 0.05 (January to August 16th)

05

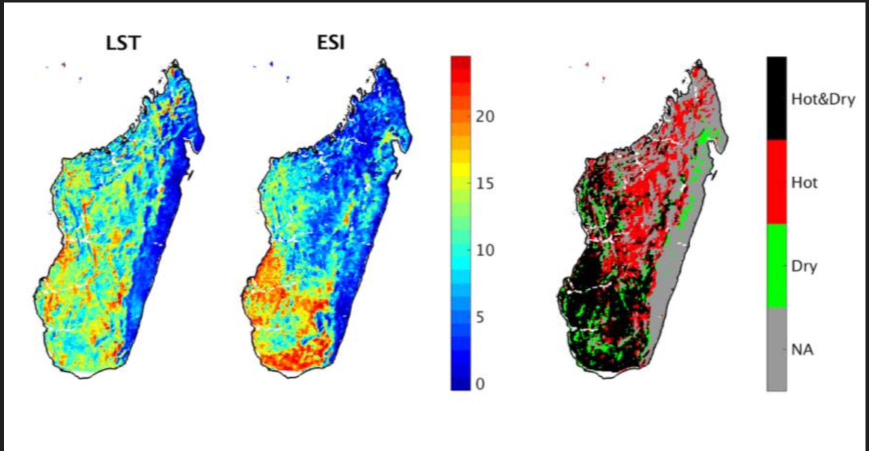
Drought and heatwave

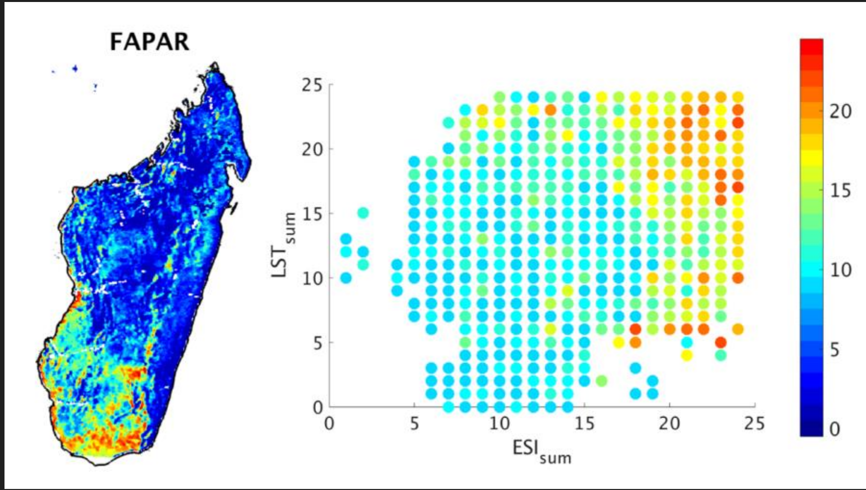
... and vegetation and carbon uptake

05 Droughts and Heatwaves



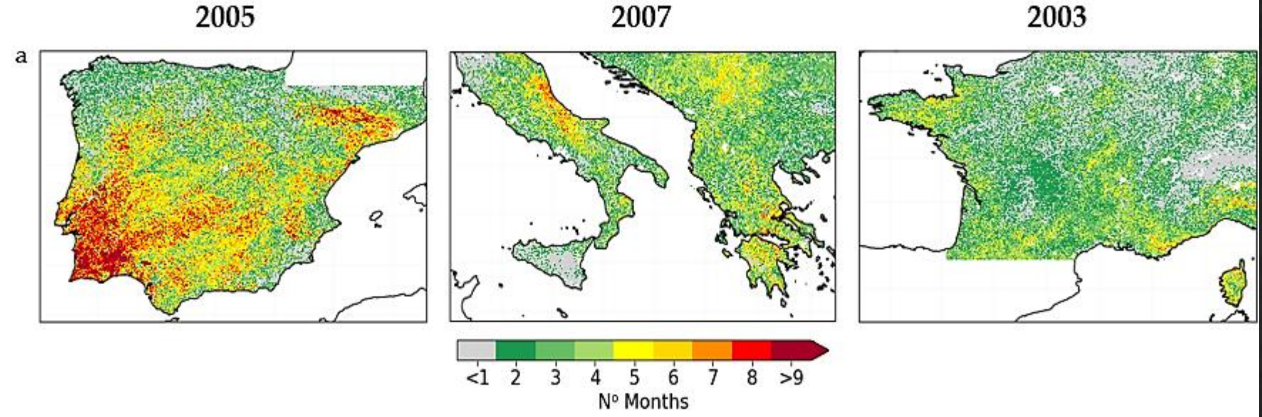
LST, ET, ET0, FAPAR
SEVIRI – MSG
2004-2021



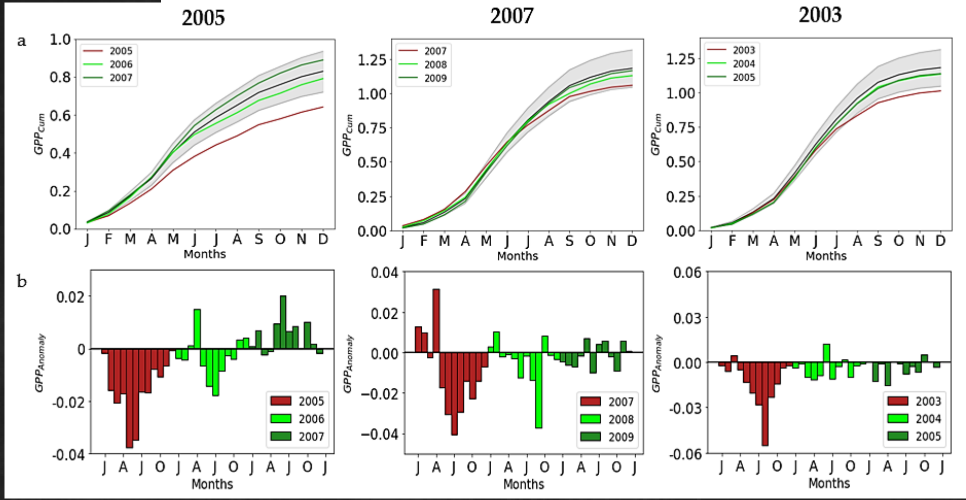


Gouveia et al (2023)

05 Droughts and Heatwaves



Monthly GPP_{ANOM} below -1σ during at least 5 months



(Ermitão et. al 2021)

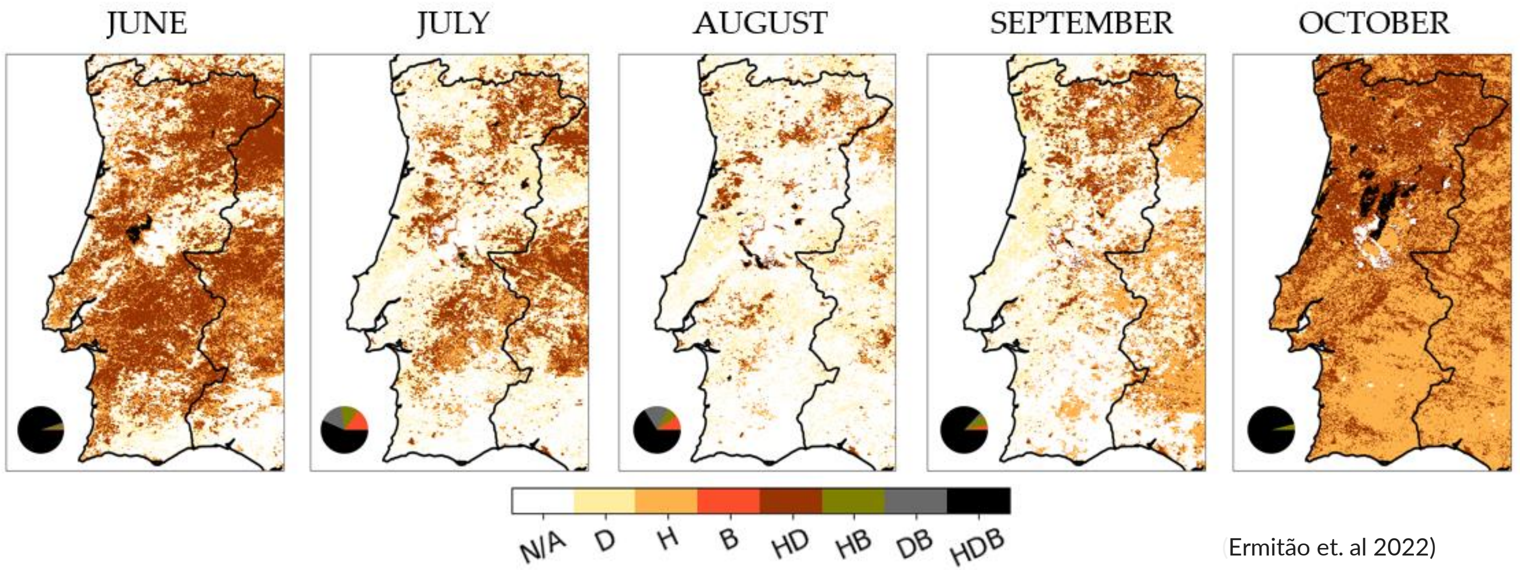
Annual GPP Balance	IB		EM		WE	
	2005	2012	2003	2007	2003	2006
Extreme Year Productivity Losses	−46.98	−10.19	−21.12	−9.31	−7.72	−13.58
1st Year of Recovery	−8.99	3.60	−1.12	−3.64	−2.11	3.72
2nd Year of Recovery	14.91	1.93	−2.49	−1.15	−2.00	−2.58
3-Year Productivity Balance	**−41.06**	**−4.66**	**−24.73**	**−14.10**	**−11.93**	**−12.44**

06

Drought, heatwave and Fires

(Wolf and Paul-Limoges. 2023)

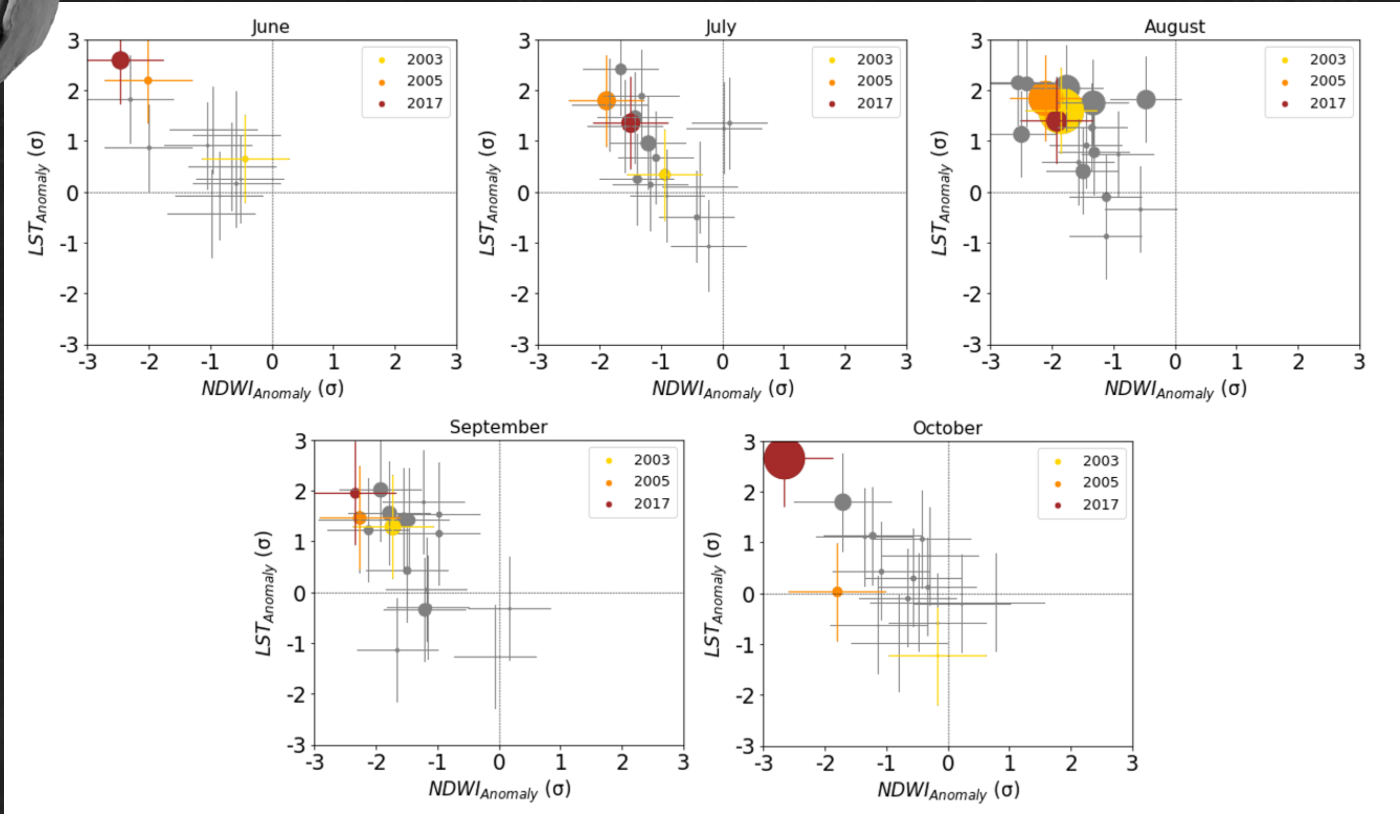
06 Droughts, Heatwaves and Fires



(Ermitão et. al 2022)

Burned only, B ($LST_{ANOM} < 1\sigma$ and $NDWI_{ANOM} > -1\sigma$)
Hot and Burned, HB ($LST_{ANOM} > 1\sigma$)
Dry and Burned, DB ($NDWI_{ANOM} < -1\sigma$)
Hot, Dry and Burned, HDB ($LST_{ANOM} > 1\sigma$ and $NDWI_{ANOM} < -1\sigma$)

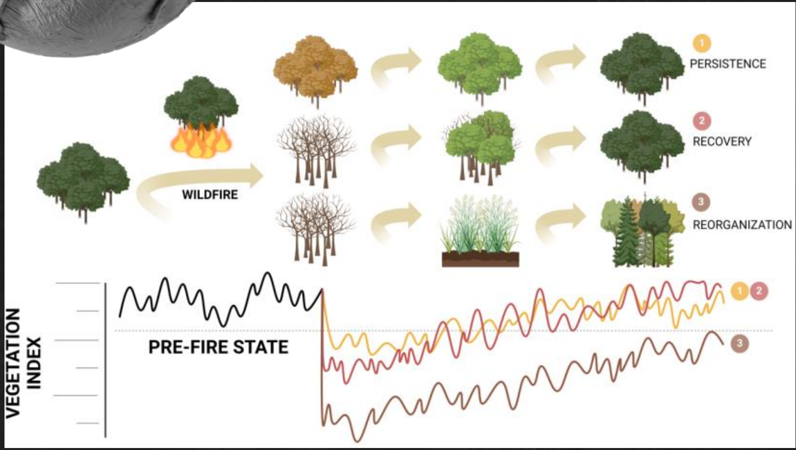
06 Droughts, Heatwaves and Fires

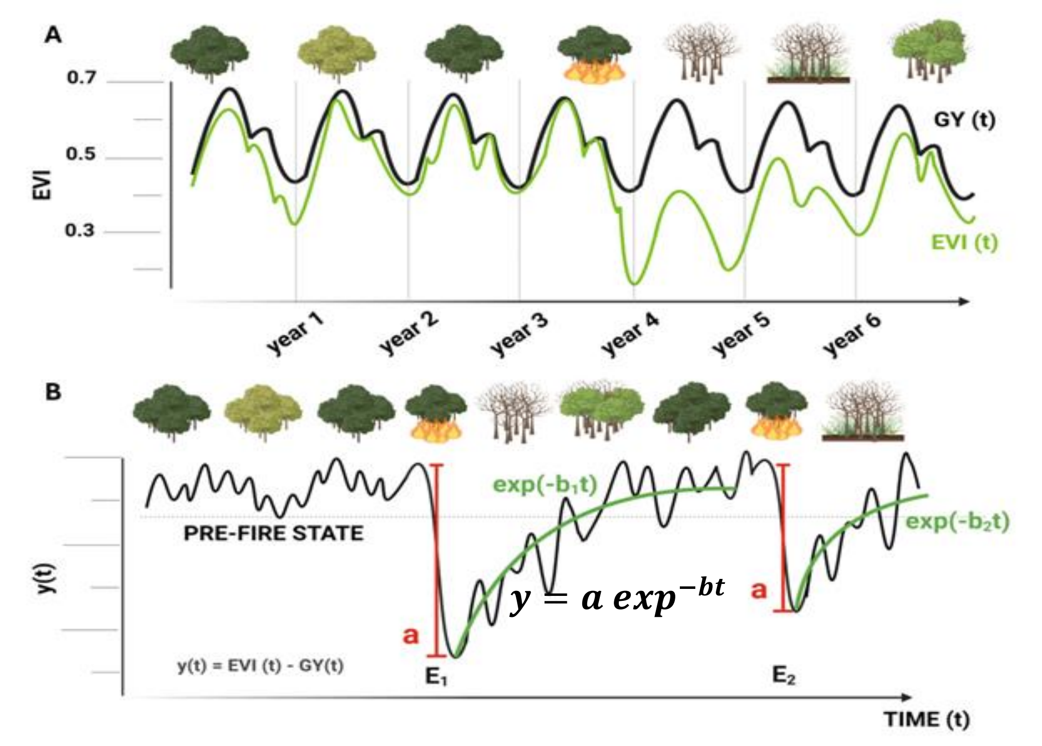


(Ermitão et. al 2022)

Selectivity of fires over areas **simultaneously** under the effect of **hot/dry** conditions.

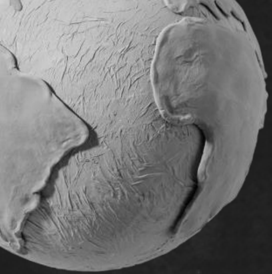
05 Droughts, Heatwaves and Fires



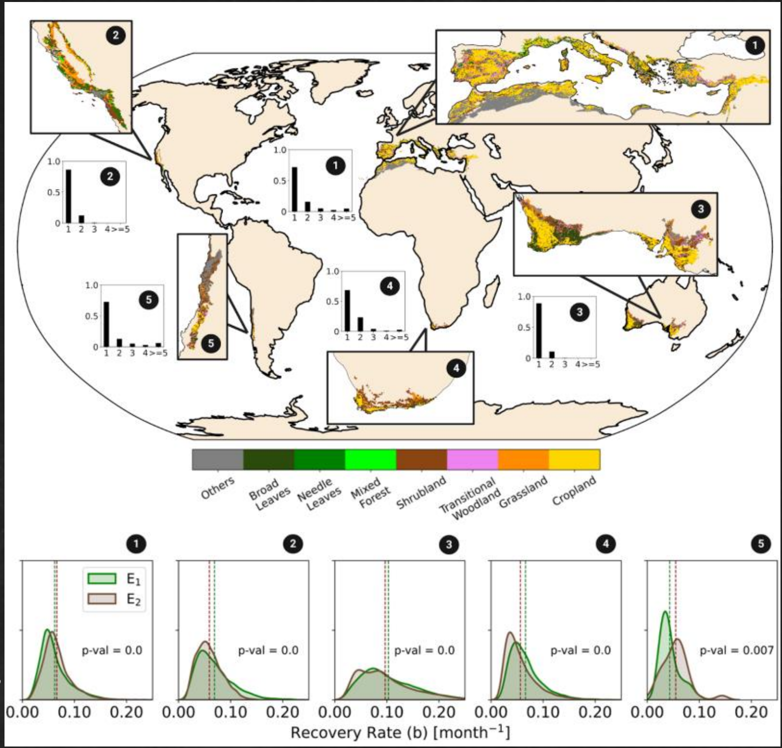


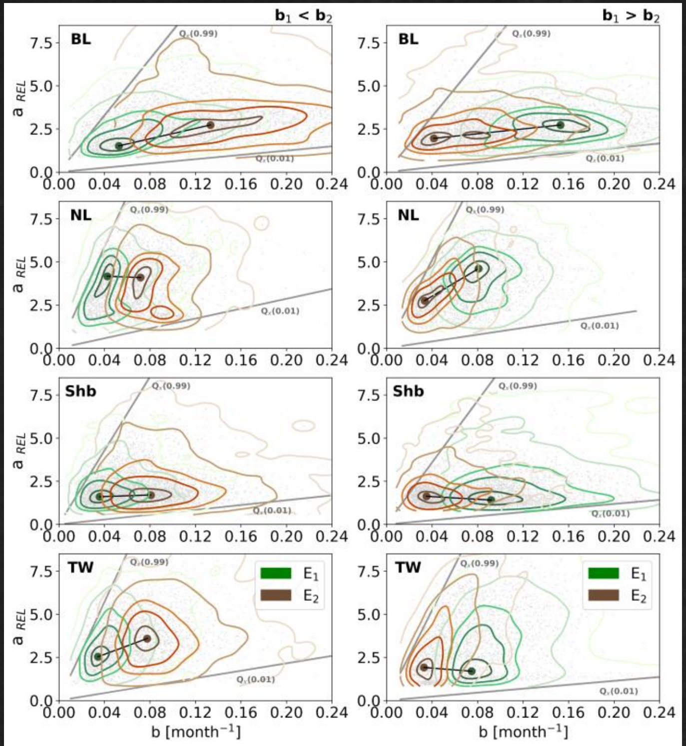
Mono-parametric statistical model

(Gouveia et al., 2010, 2018; Bastos et al., 2011)



06 Droughts, Heatwaves and Fires



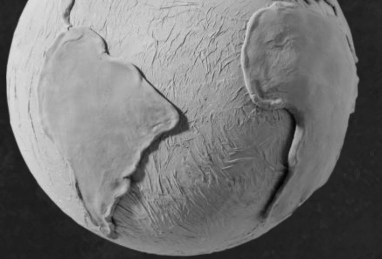


(Ermitão et. al (in revision, Global Change Bilology)

Vegetation tends to recover faster after the second event than the first event,

Recovery rates dependent on fire severity, especially for higher severity values.

05 Take home messages



Fire

Lightning

A scientist investigates the event and finds:

- Lightning sparked the fire and was the main cause.

- Other factors played a minimal role.

Compound event fire

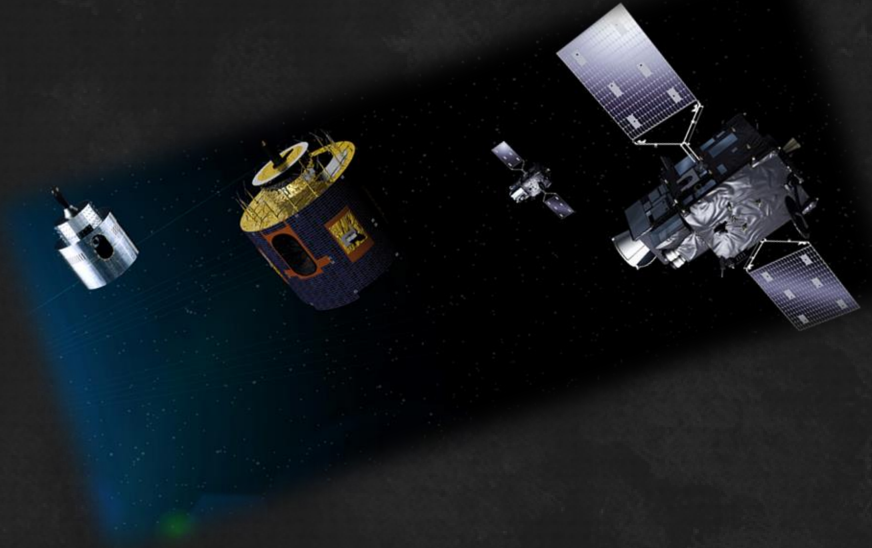
Strong wind | Lightning | Drought | Heatwave

A scientist investigates the event and finds:

- Multiple problems caused the fire and helped it spread.

- Different factors affected the severity of the fire.

climate extremes
ARC centre of excellence



Thanks!

Do you have any questions?

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Many thanks to my co-authors

Carlos DaCamara
Isabel Trigo
Ricardo Trigo
Ana Russo
Ana Bastos
Andreia Ribeiro
Tiago Ermitão
Catarina Alonso
Raquel Santos