First EUSO Stakeholders Forum
- Young Soil Researchers Forum

Forest management effectivity to reduce wildfire severity and avoid soil degradation in Mediterranean forest

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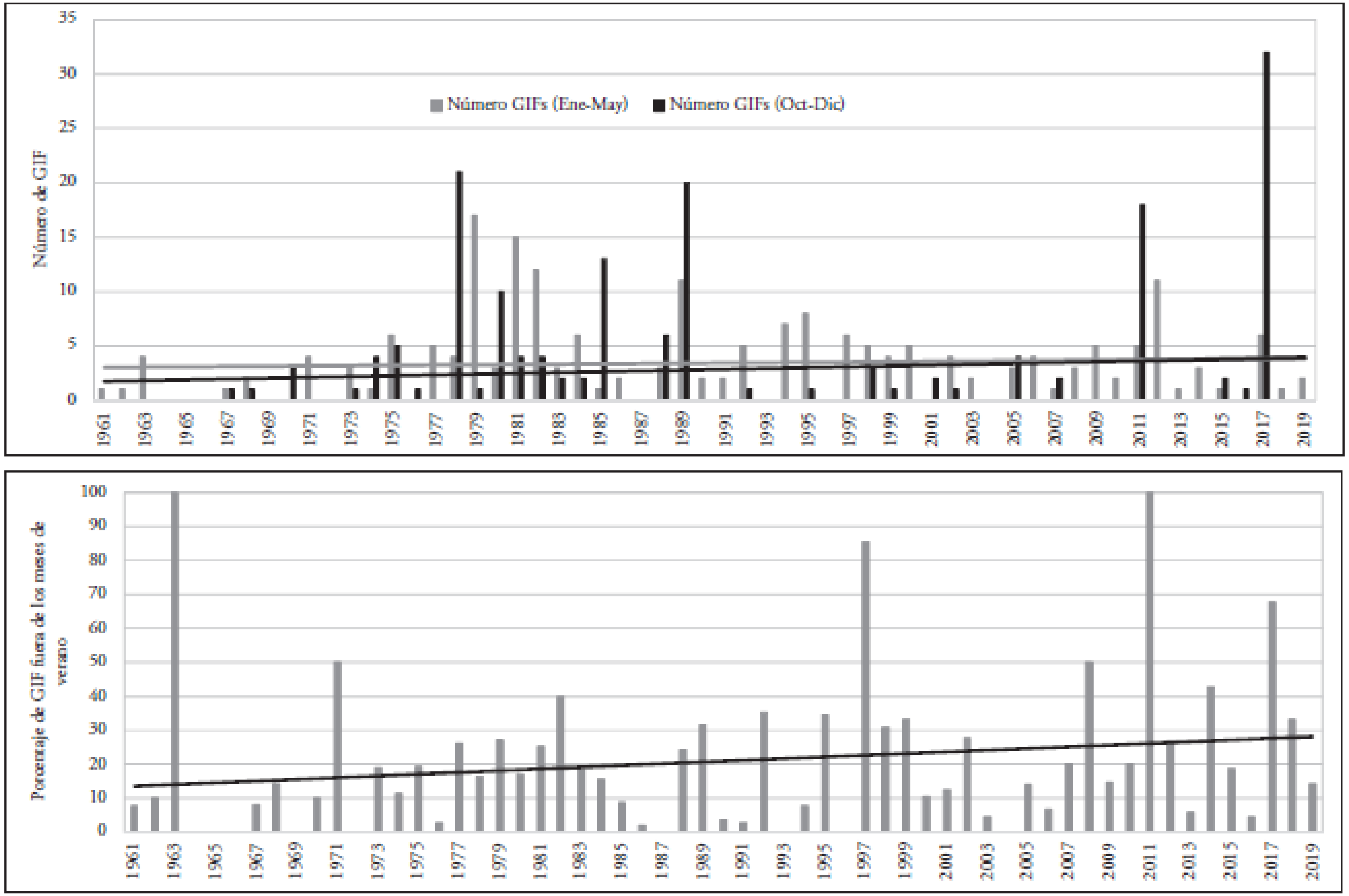
HISTORICAL LAND USE

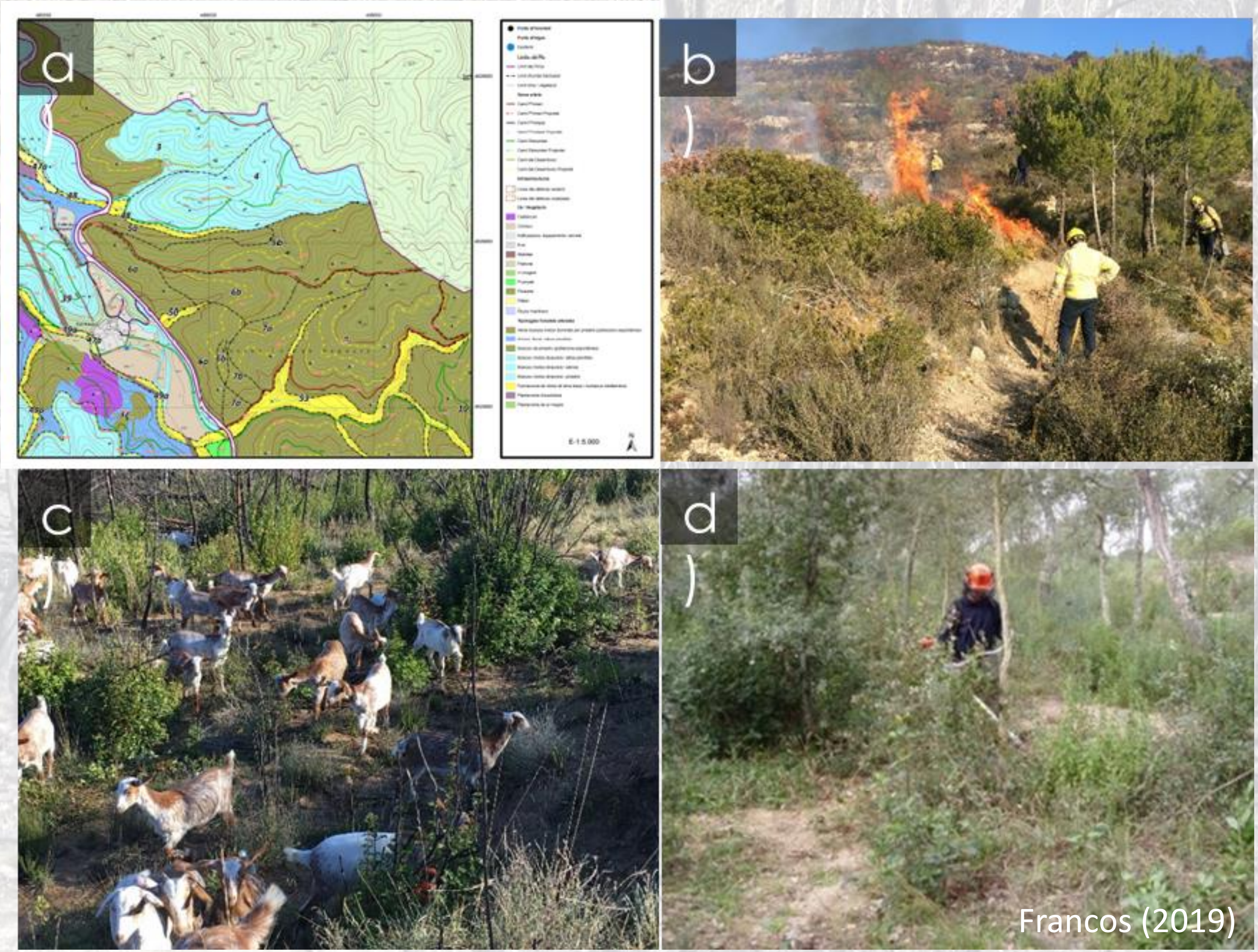


Number of Large Forest Fires during autumn, winter and spring months (1961 - 2019)

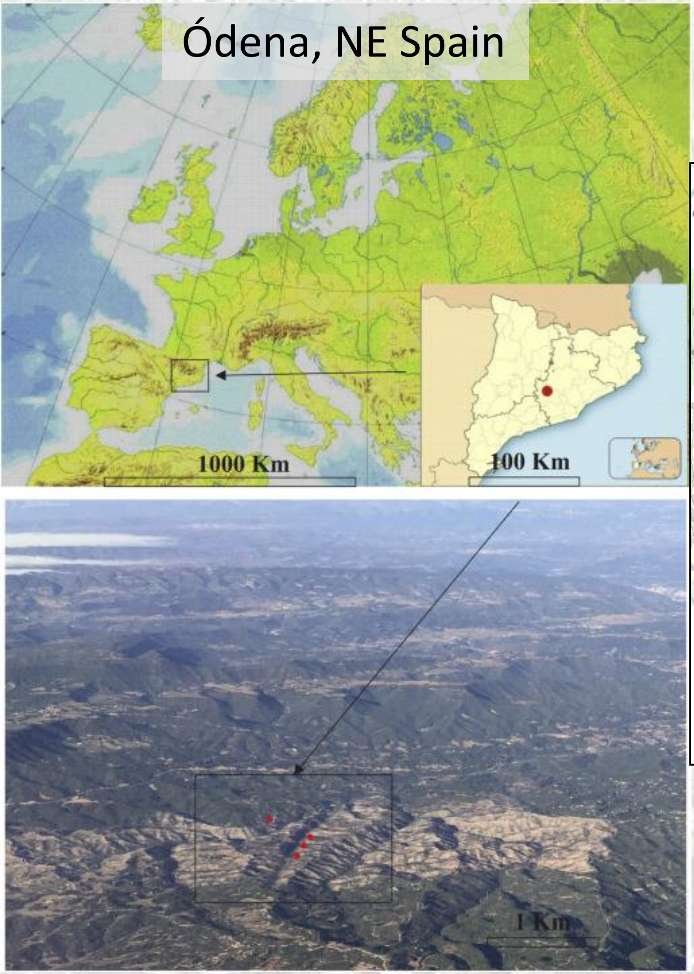
Percentage of Large Forest Fires during autumn, winter and spring months (1961 - 2019) with respect to total GIFs by year (1961 – 2019)

Deseasonalisation of forest fires and the need for management to prevent degradation

Úbeda et al. (2021)

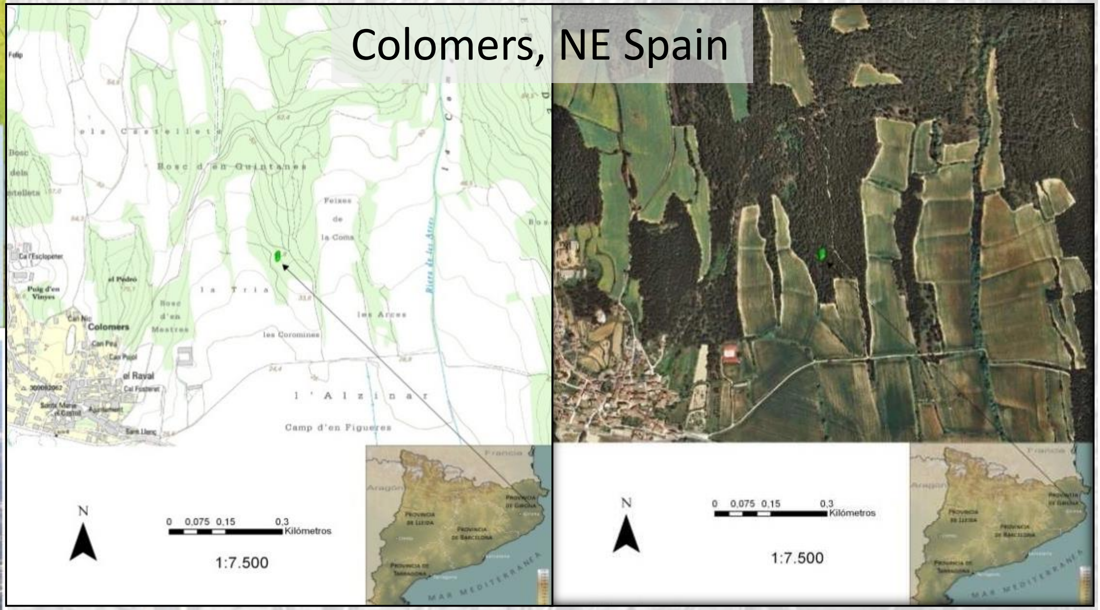

a
b
c
d
Francos (2019)

The research question is, in a context of global change, how can we better manage the forest to avoid soil degradation in areas where forest fires are recurrent?

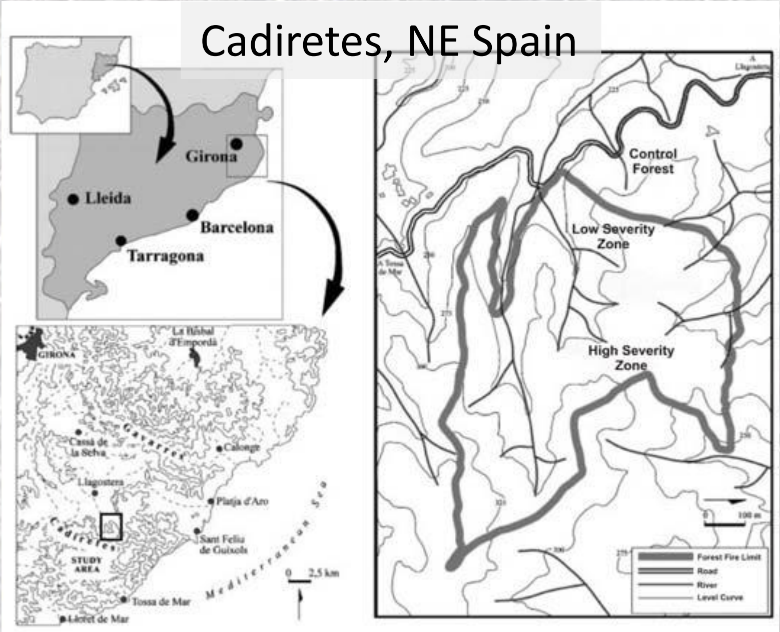


Soil: Francos et al. (2018b), Francos et al. (2018c), Francos et al. (2020a), Francos et al. (2021)

Vegetal recovery: Francos et al. (2020b)



Soil: Francos et al. (2016a), Francos et al. (2019a), Francos et al. (2019b)



Soil: Francos et al. (2018a)

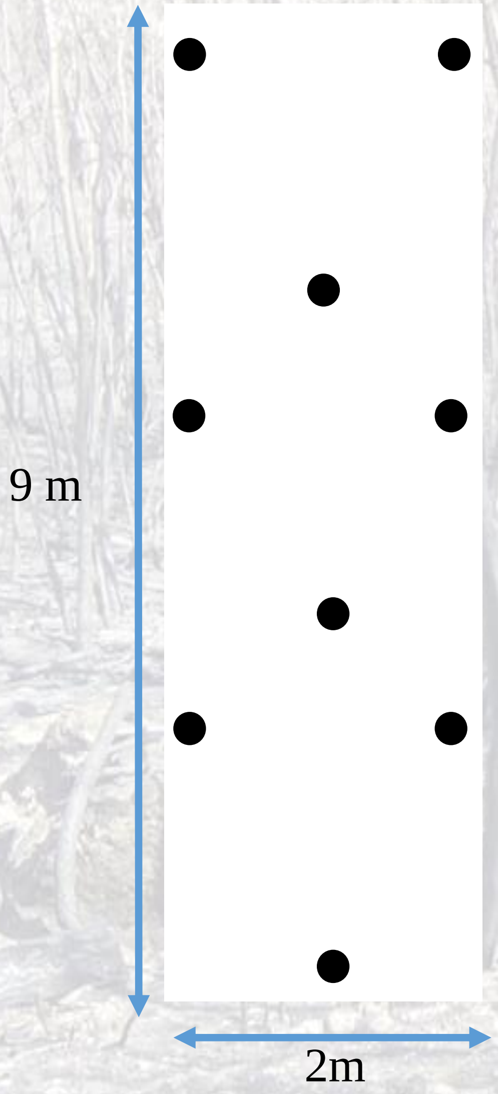
Vegetal recovery: Francos et al. (2016b), Francos and Lemus-Canovas (2021)

We mainly evaluated:

A. Effectiveness of pre-fire management: clear-cutting and/or prescribed fire to avoid degradation caused by a high severity wildfire.
B. Evaluation of different post-fire managements to find the best practice to avoid soil degradation: manual or mechanical cutting and removal of wood, no treatment and livestock (cows and goats).
C. Influence of topography and the confluence of natural events on the impact of wildfire on soil properties.
D. Long-term studies and Incorporation of the different forestry practices in the forest management plans so that their implementation is regular and maintained over time.

The methods have therefore been adapted to each study, and in general terms the methods have been as follows

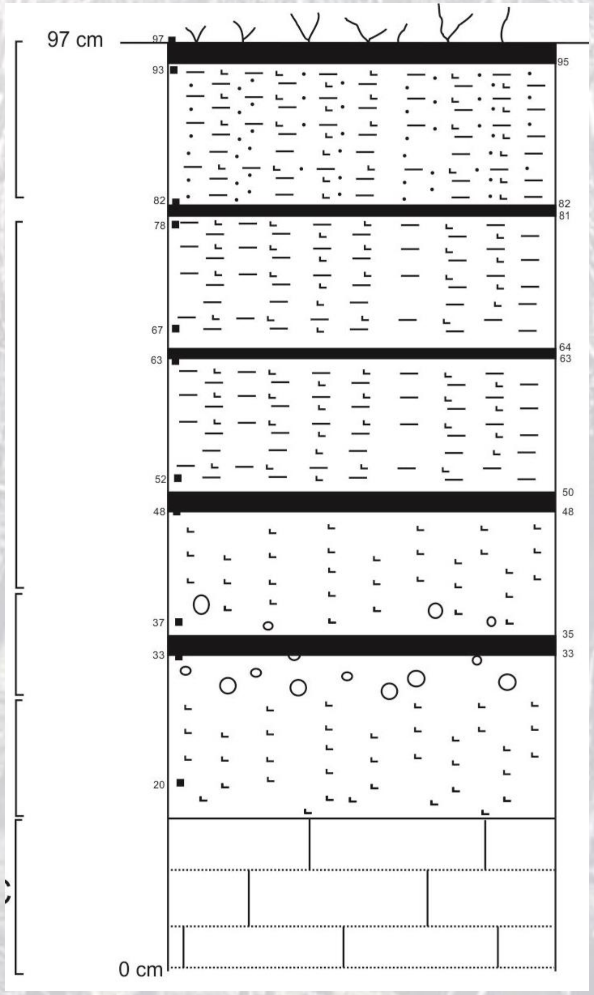
Experimental design and sampling



9 topsoil samples (0-5 cm)

10 topsoil samples (0-5 cm)

30 topsoil samples (0-5 cm)



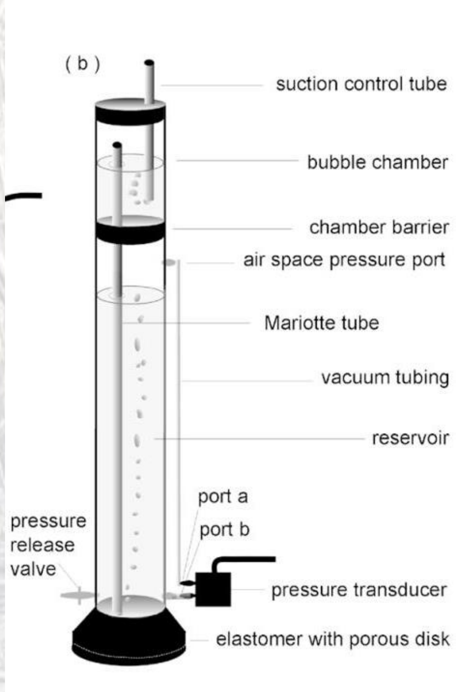
Sampling at different depths

Soil samplings along time to study the evolution of soil properties

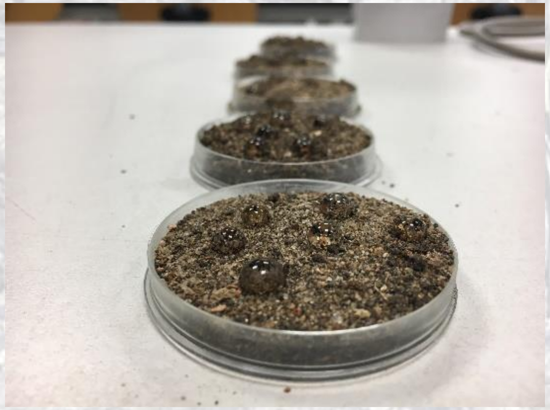
Laboratory methods

1 m

Soil Agreggate Stability
Ten drop impact method

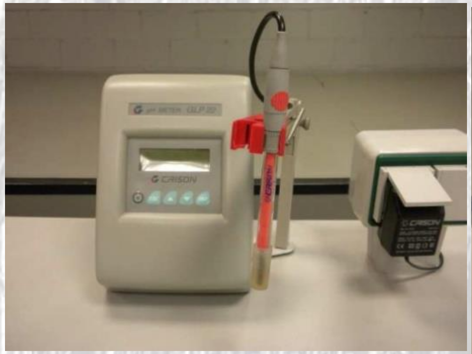


Infiltration Capacity
Source: Soil Science Society of America



Soil Water repellency
Using WDPT (Water Drop Penetration Time)

Total Nitrogen (TN)

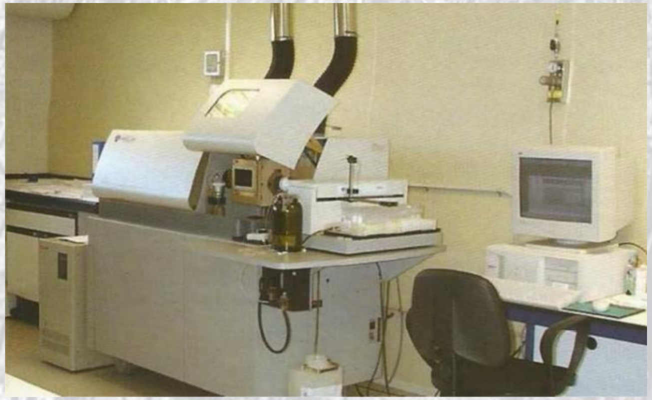


pH

Electrical Conductivity (EC)

Inorganic Carbon

Soil Organic Matter



Exchangeable bases: Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), Aluminum (Al), Manganese (Mn), Iron (Fe), Zinc (Zn), Silicon (Si) and Sulfur (S).

Microbial biomass carbón (Cmic)

Soil Basal Respiration (BSR)

Statistical analysis

Data Normality and Homogeneity

Assessment

Shapiro-Wilk y Levene

Gaussian distribution and respected the variances homogeneity

Was applied

One-Way ANOVA or Two-Way ANOVA

NOT Gaussian distribution and respected the variances homogeneity

Was applied

Kruskal-Wallis

Significant differences at $p < 0.05$

Tukey post-hoc

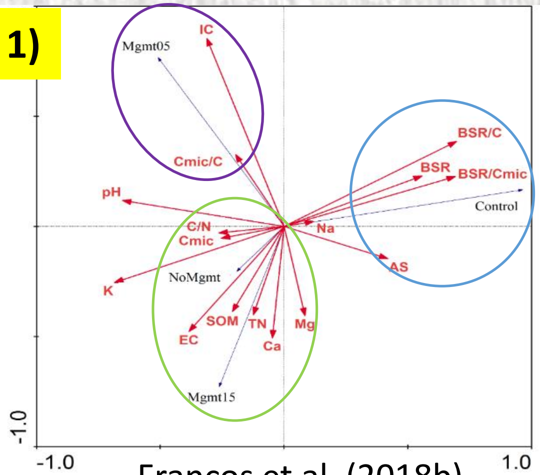
Was applied

SPSS 23.0

CANOCO 4.5

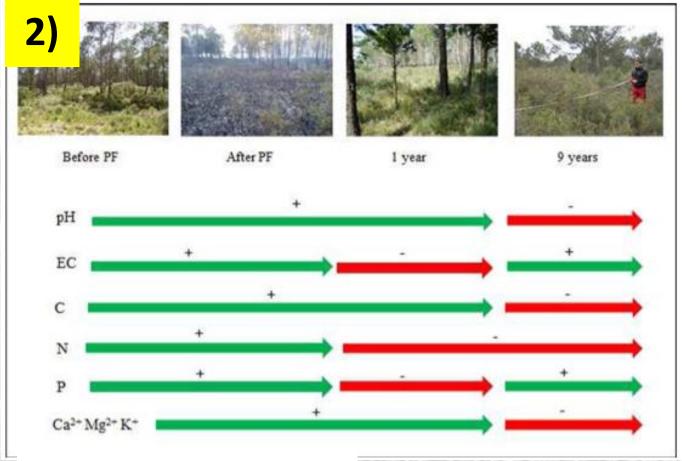
JASP 0.9.1

1)



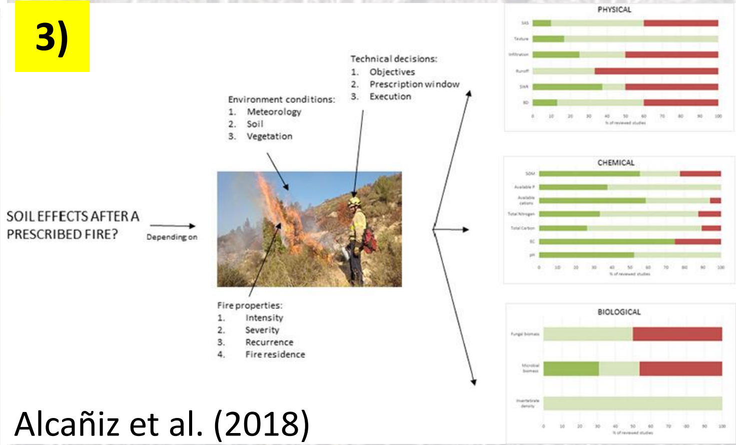
Francos et al. (2018b)

2)



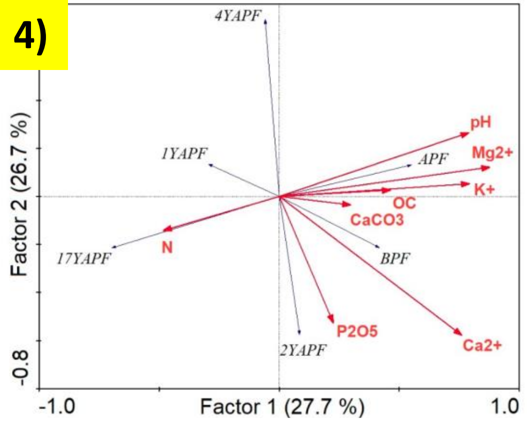
Alcañiz et al. (2016)

3)



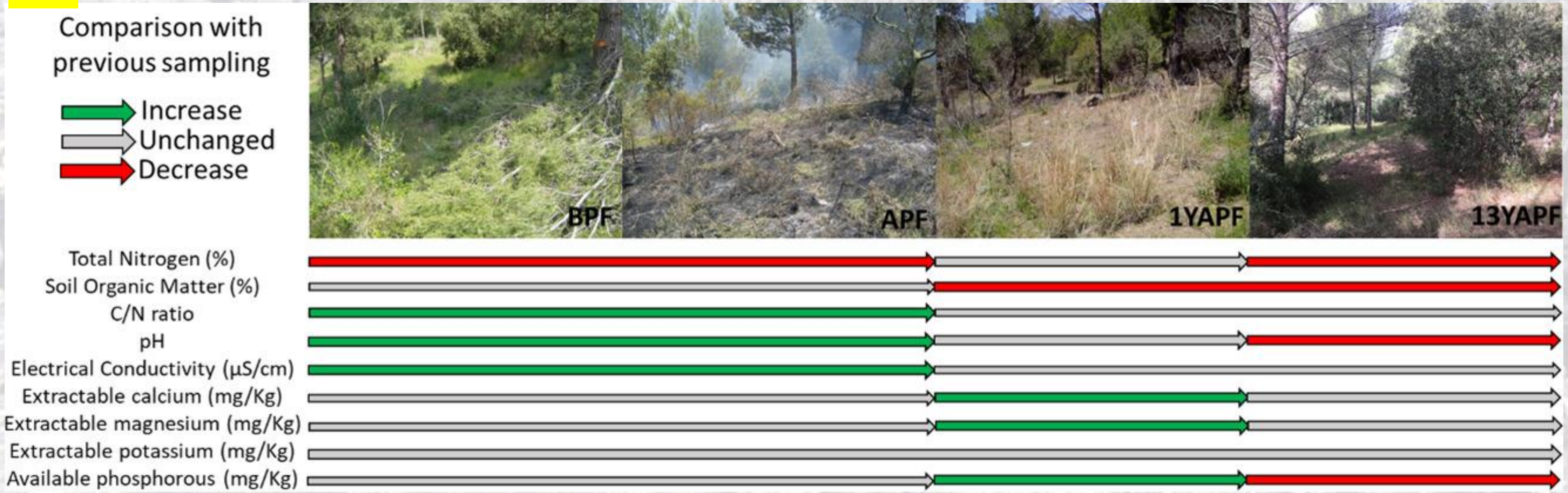
Alcañiz et al. (2018)

4)



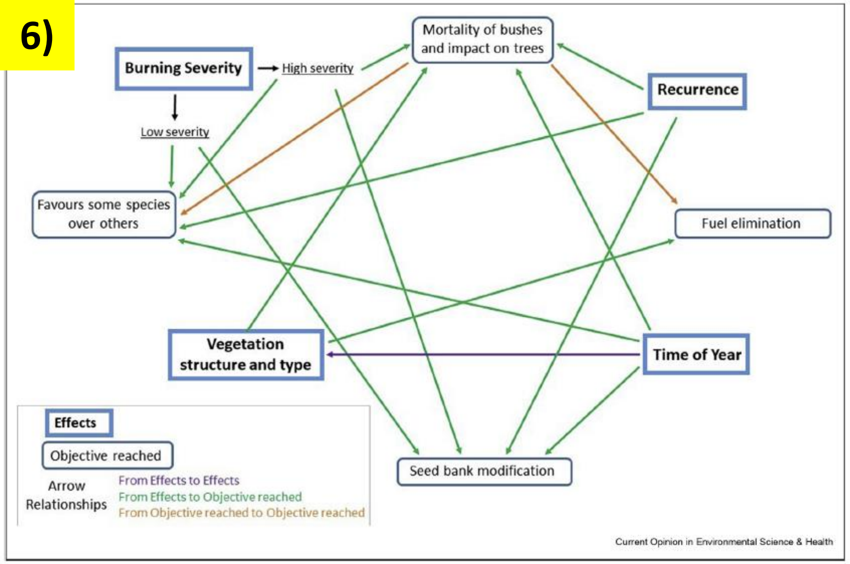
Úbeda et al. (2019)

5)



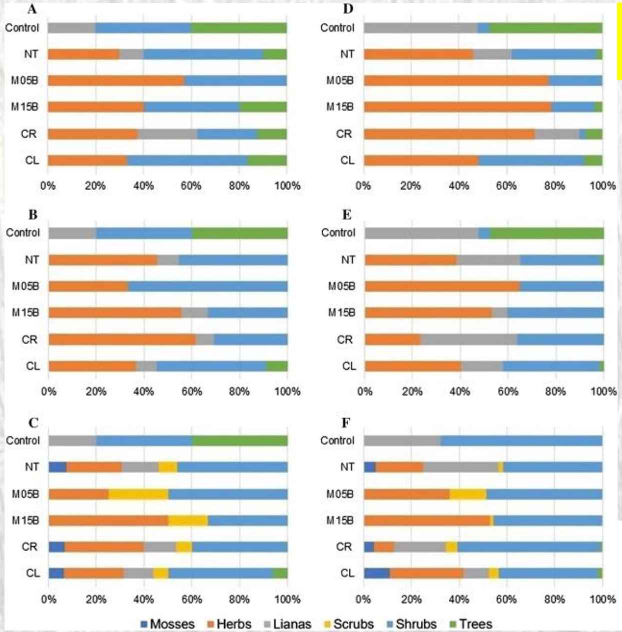
Francos et al. (2019b)

6)



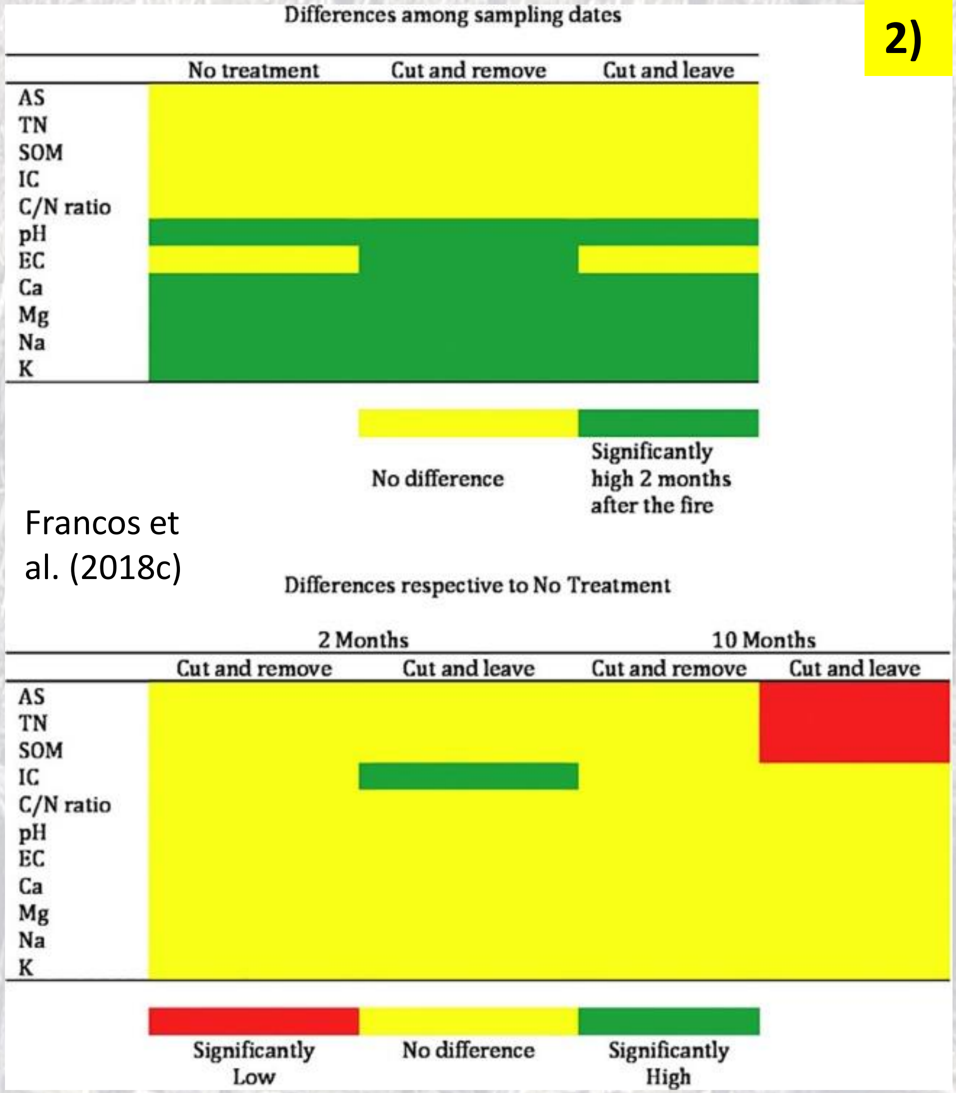
Francos and Úbeda (2021)

1)



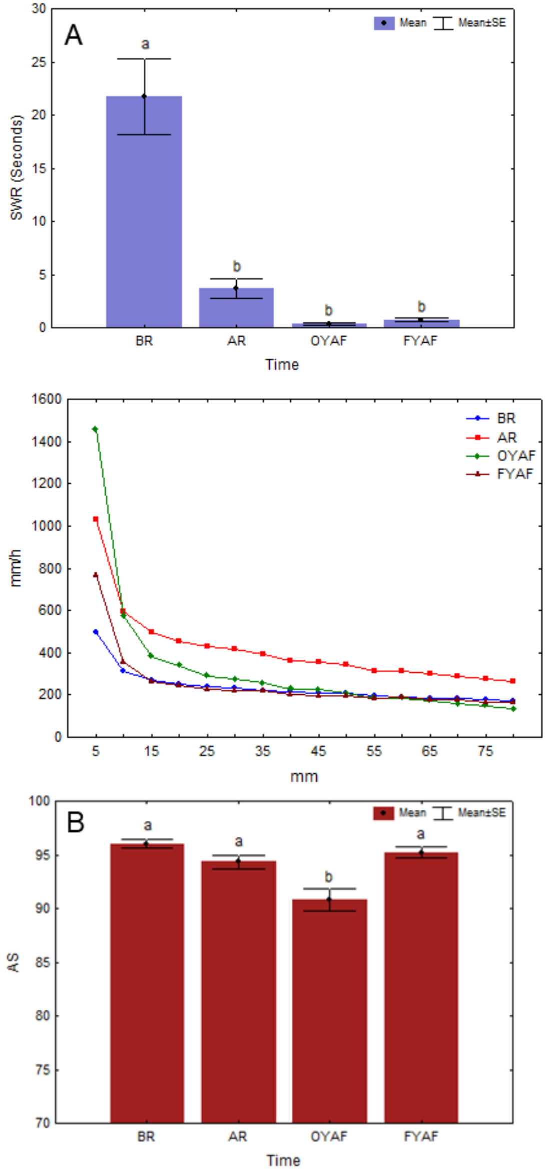
Francos et al. (2020a)

2)



Francos et al. (2018c)

3)



Francos et al. (2019a)

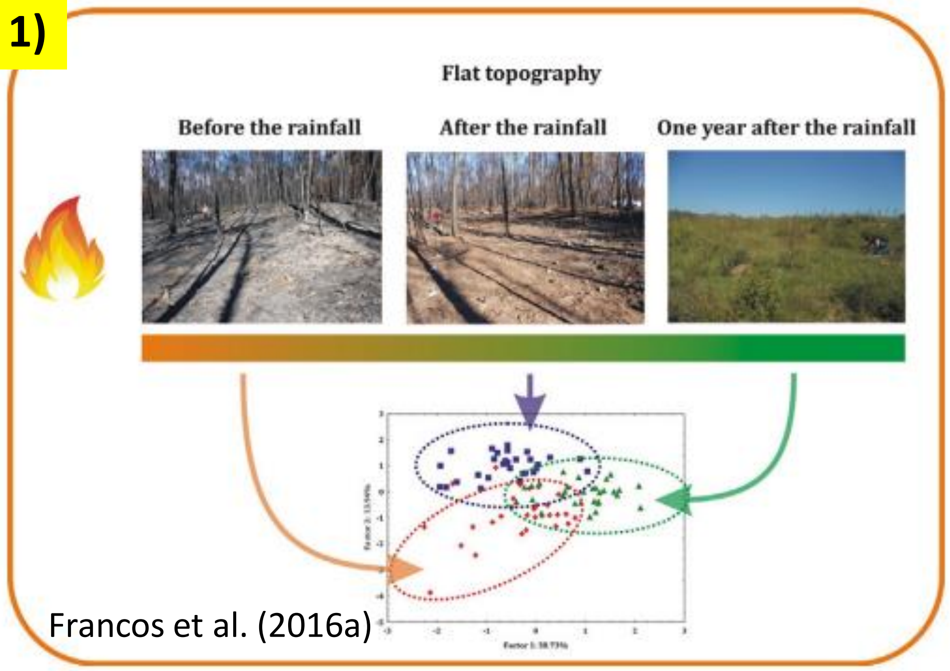
4)

Table 2 ANOVA of the variables related to erosion and runoff after a rainfall simulation in seven land uses. (cont.)

Variables	Study plots	Mean	Standard deviation	*P*-value
Contribution (L·m^{-2})	Dense forest	0.80 c	0.33	**
	Quercus suber with recent management	0.35 c	0.07	
	Q. suber with two-year management	5.32 b	3.26	
	Pinus halepensis with recent management	0.18 c	0.06	
	P. halepensis with two-year management	0.57 c	0.30	
	Bare area	5.75 b	1.40	
	Forest road	14.59 a	1.69	
Runoff coefficient (%)	Dense forest	0.31 c	0.46	**
	Q. suber with recent management	0.05 c	0.02	
	Q. suber con with two-year management	1.20 b	0.22	
	P. halepensis con with recent management	0.04 c	0.06	
	P. halepensis with two-year management	0.06 c	0.02	
	Bare area	4.08 b	1.12	
	Forest road	12.46 a	3.75	
Erosion /rainfall (g·L^{-1})	Dense forest	0.0075 b	0.0148	**
	Q. suber with recent management	0.0001 b	0.0001	
	Q. suber with two-year management	0.0088 b	0.0075	
	P. halepensis with recent management	0.0014 b	0.0013	
	P. halepensis with two-year management Bare area Forest road	0.0002 b 0.0040 b 0.6958 a	0.0001 0.0015 0.1132	
Erosion /runoff (g·L^{-1})	Dense forest	0.42 c	0.05	**
	Q. suber with recent management	0.34 c	0.12	
	Q. suber with two-year management	0.42 c	0.05	
	P. halepensis with recent management	2.74 b	0.67	
	P. halepensis with two-year management	0.24 c	0.04	
	Bare area	0.62 c	0.09	
	Forest road	6.51 a	1.20	
Erosion (g·m^{-2})	Dense forest	0.35 b	0.19	***
	Q. suber with recent management	0.12 b	0.05	
	Q. suber with two-year management	2.14 b	1.26	
	P. halepensis with recent management	0.49 b	0.21	
	P. halepensis with two-year management	0.14 b	0.07	
	Bare area	3.54 b	0.83	
	Forest road	96.02 a	25.56	

Úbeda et al. (2020a)

1)



Francos et al. (2016a)

2)

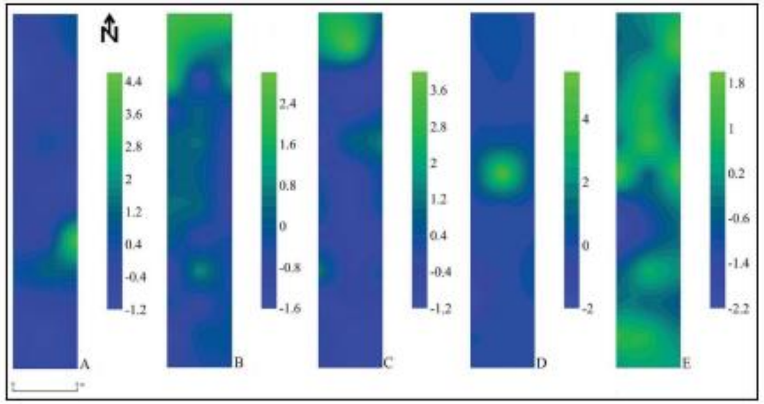


Figure 5. Interpolation maps with the results of factor scores in first sampling: A) Factor 1; B) Factor 2; C) Factor 3; D) Factor 4; and E) Factor 5

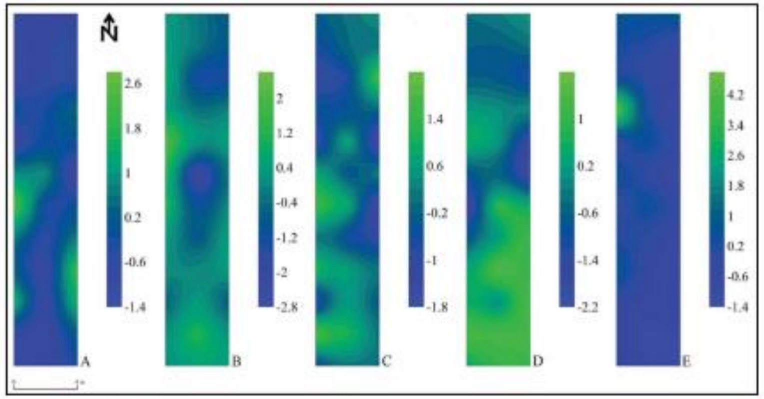
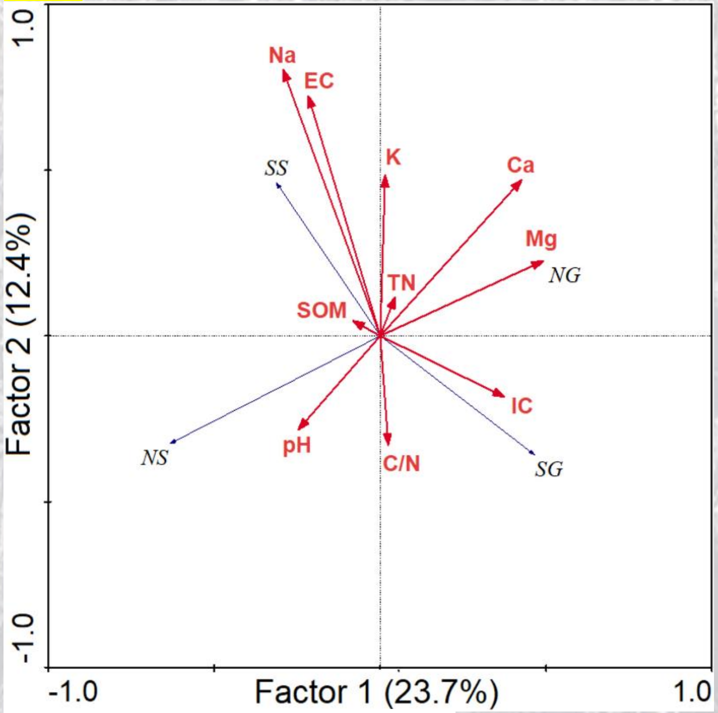


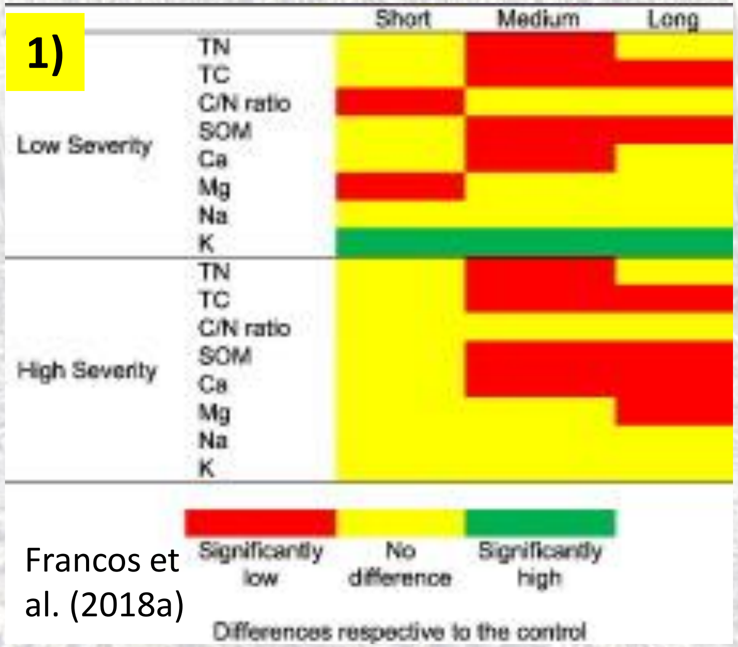
Figure 6. Interpolation maps with the results of factor scores in second sampling: A) Factor 1; B) Factor 2; C) Factor 3; D) Factor 4; and E) Factor 5.

Francos et al. (2019c)

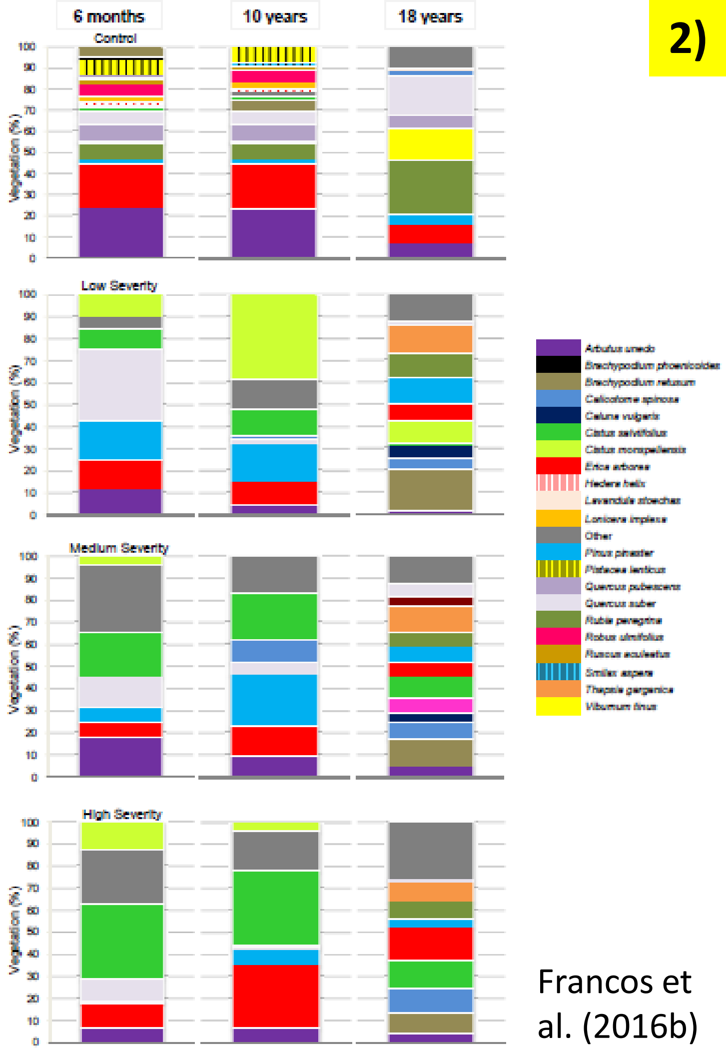
3)



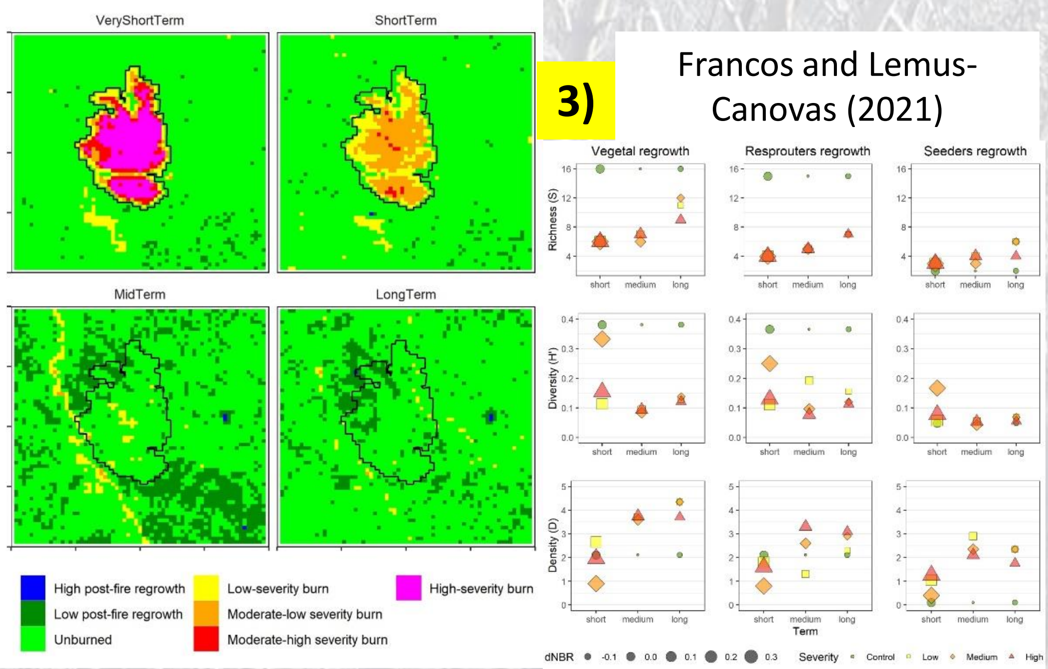
Francos et al. (2021)



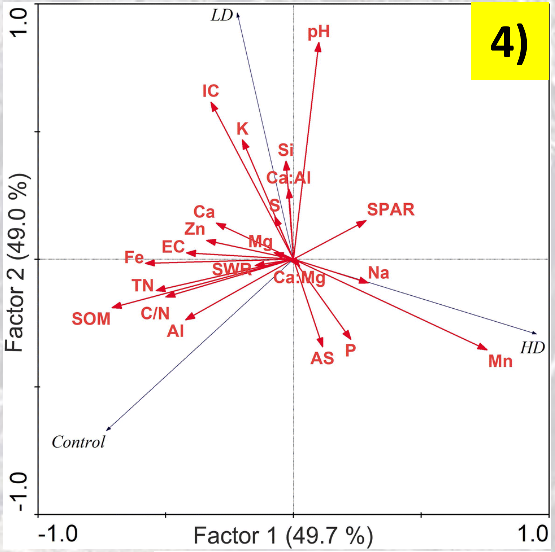
Francos et al. (2018a)



Francos et al. (2016b)



Francos and Lemus-Canovas (2021)



Francos et al. (2020b)

- ✓ **Pre-fire management can remain low fuel vegetal density, helping to decrease the wildfire risk, but more research needs to be done to determinate the best practice and how often the management should be done. Post-fire management can prevent soil degradation and erosion if is carried out properly not only after the fire impact.**

- ✓ **Due to deseasonalisation of wildfires, a common event will be the confluence of fire and torrential rainfalls. After these, evaluate its impact and possible amendments according to topographical conditions is essential to maintain soil quality and health. Long-term studies reveal that in many burned areas, post-fire management is recommended to avoid fuel vegetal continuity, density and soil stress.**

- ✓ **It is necessary to rethink forest areas, to revalue forests and the ecosystem services they provide, in order to promote rural life that preserves forests and soils in these areas.**

- ✓ **We must look for strategies to ensure that forests can adapt to future conditions, instead of think about returning to the forest stands of the past. It is necessary to think about the environmental conditions of the future and design sustainable forest management that creates resilient forest adapted to those future conditions.**

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THANK YOU FOR YOUR ATTENTION

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