Fire history imprints and resilience of burned soils

PHD PROJECT
PERIOD 2023-24

UNIVERSITAS Miguel Hernández

PROGRAMA DE DOCTORADO EN
MEDIO AMBIENTE Y SOSTENIBILIDAD
UNIVERSITAS Miguel Hernández

Luis D. OLIVARES-MARTINEZ

PhD on Environment and Sustainability

UNIVERSITY MIGUEL HERNANDEZ
(ELCHE, SPAIN)

GETECMA
Grupo de Edafología y Tecnologías del Medio Ambiente
UNIVERSITAS Miguel Hernández

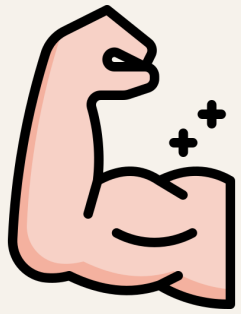
LET'S TALK ABOUT FIRE

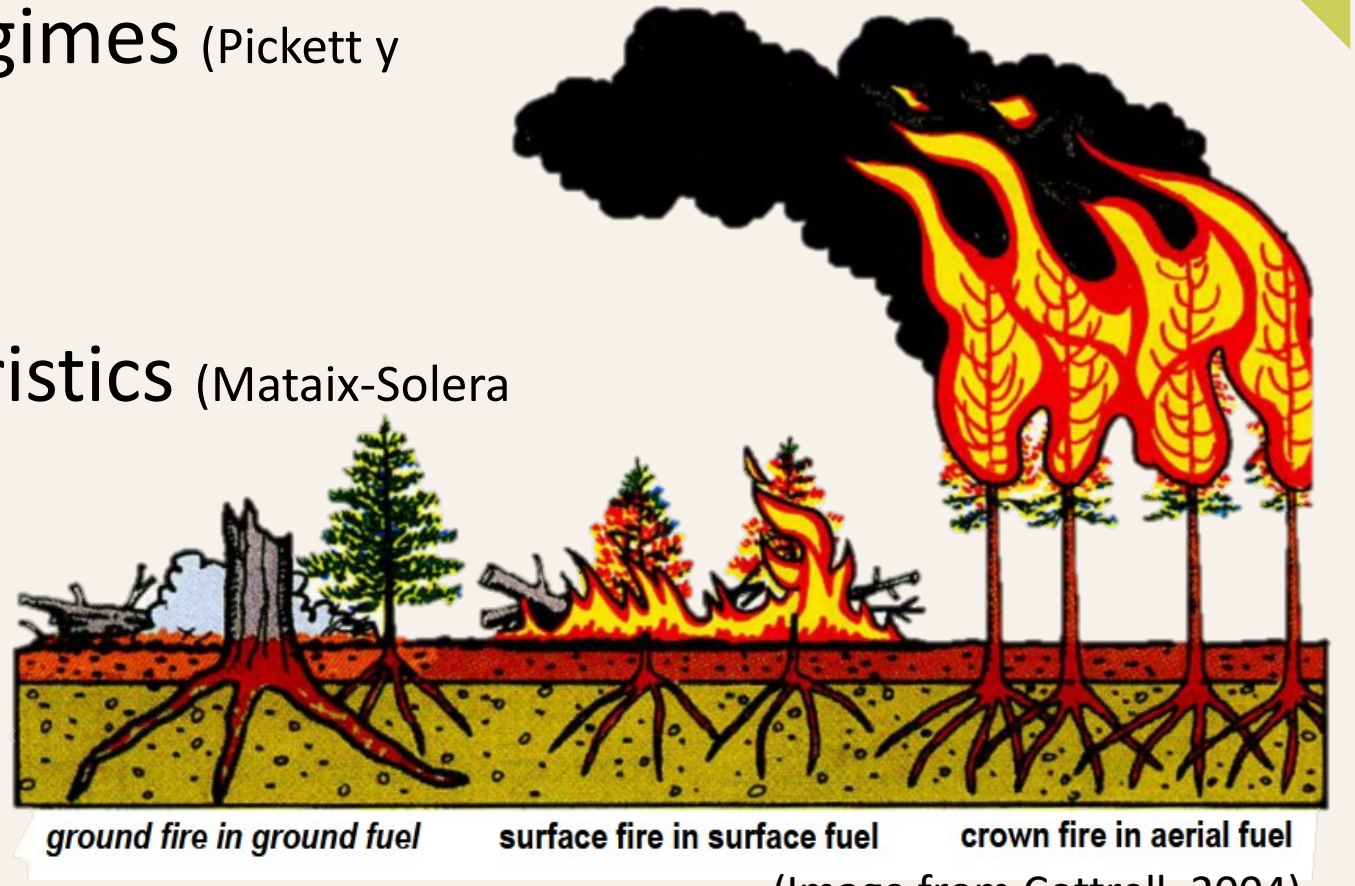
Theoretical approaches:

Disturbance ecology and regimes (Pickett y White, 1985)

Fire regimes (Gill, 1975; Agee, 1993)

Fire effects on soil characteristics (Mataix-Solera *et al.*, 2007; Bento-Gonçalves *et al.*, 2012)





(Image from Cottrell, 2004)

LET'S TALK ABOUT FIRE

What we know about fire effects on soil
(Mataix-Solera et al., 2007; Bento-Gonçalves et al., 2012):

It changes: SOC, C:N, NPK, water repellency, land cover

It might change: pH, $\%_{sand}$, mineralogy (kaolinite), fungi/bacteria dominance, soil moisture, electric conductivity, erodibility

What we know about fire recurrence effects:

Its chances can affect forest composition and seed banks (Busby *et al.*, 2020; Saénz-Ceja & Mendoza, 2022)

High recurrences may exceed soil resistance thresholds and set the soil apart from healthy states (Moghi *et al.*, 2022; Albert-Belda *et al.*, 2023) …or maybe not (Olivares-Martínez, 2020)

Aims of this research:

General:

Enhance comprehension regarding the influence of fire recurrence on soil ecosystems, encompassing physical, chemical, and biological attributes

Specific:

Characterize the spatial distribution of fire regimes

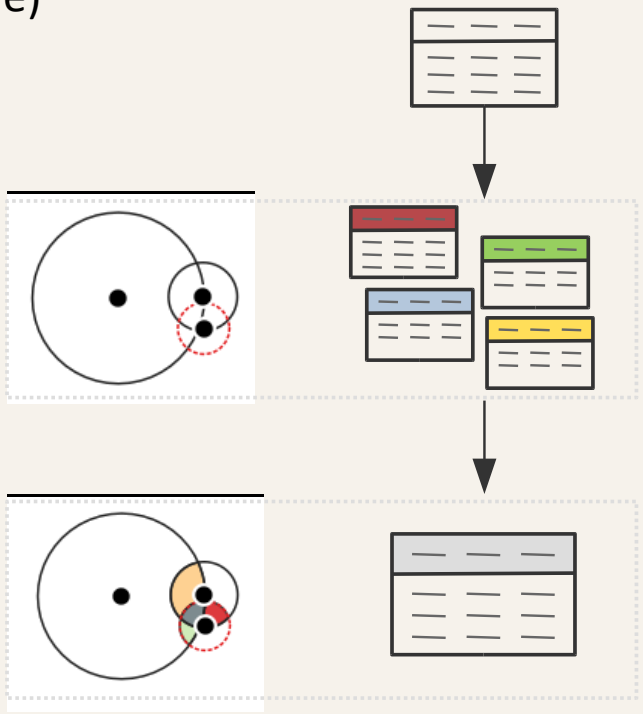
Determine soil water infiltration thresholds within different fire histories

Identify functional changes in soils burned several times

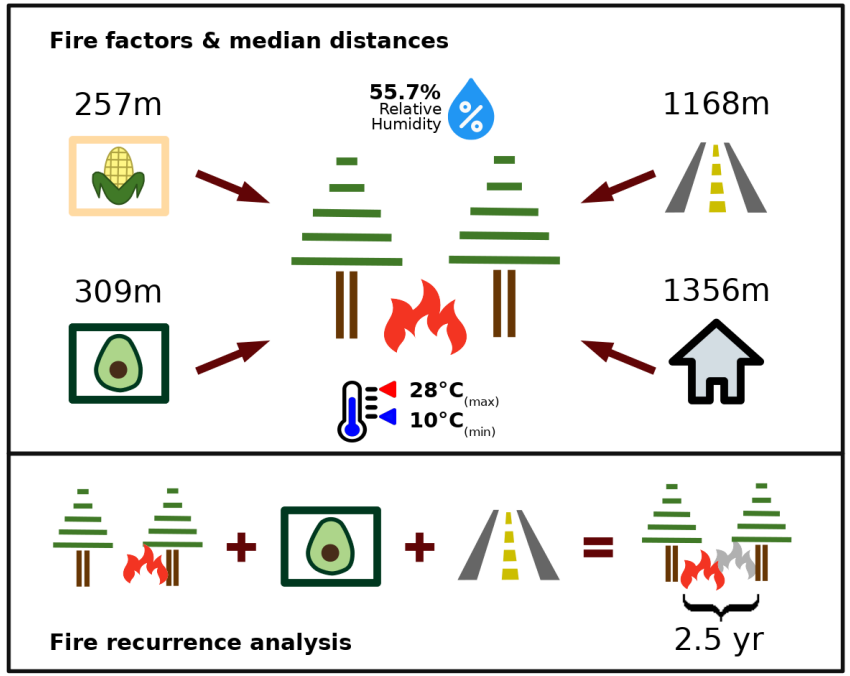
Understanding the role of physical post-fire attributes into biological ones

Spatial distribution of fire regimes (including fire recurrence)

- Vector analysis of geospatial databases (land use and vegetation, human settlements and fire)



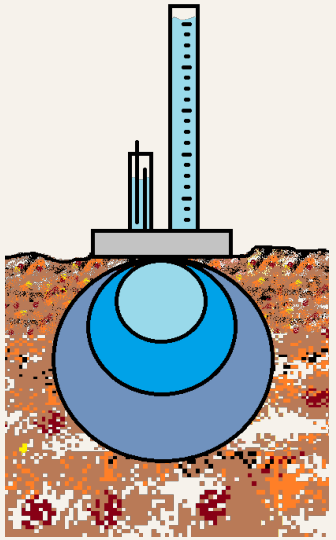
- Atmospheric data mining (weather stations and oceanic index ONI)

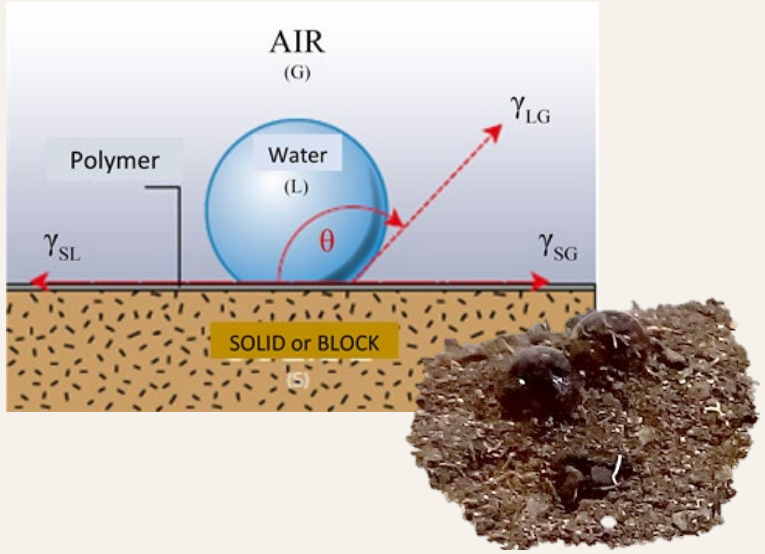


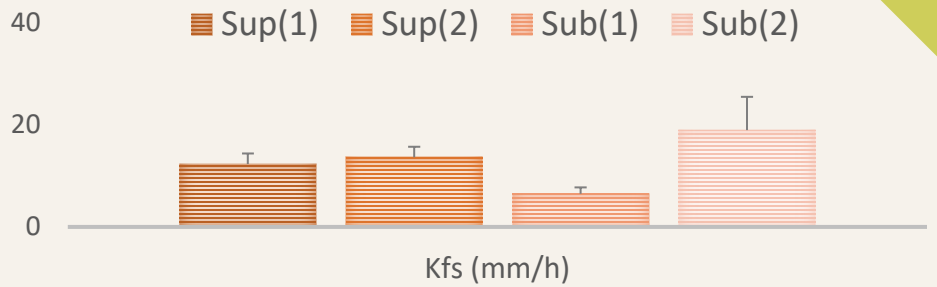
- **Olivares-Martinez, L. D.**, Gomez-Tagle, A., & Pérez-Salicrup, D. R. (**2023**). Regional Drivers behind the Burning of Remanent Forests in Michoacán Avocado Belt, Central Mexico. *Fire 2023, Vol. 6, Page 81*, *6*(3), 81.

Water infiltration thresholds within different fire histories

- Surface vs ground fire (soils with andic properties in temperate forests)
- One and two fires in the last 25 years
- Measurements of field saturated infiltration
- Integrated repellency dynamic index





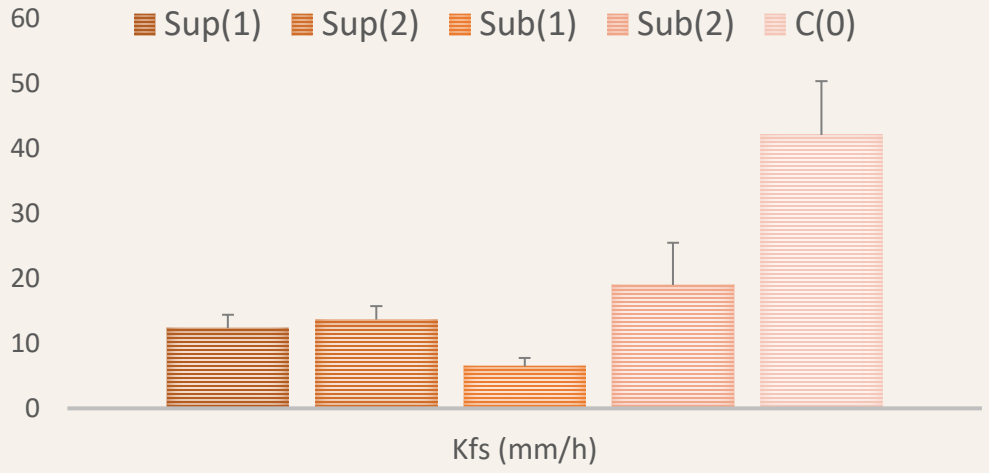


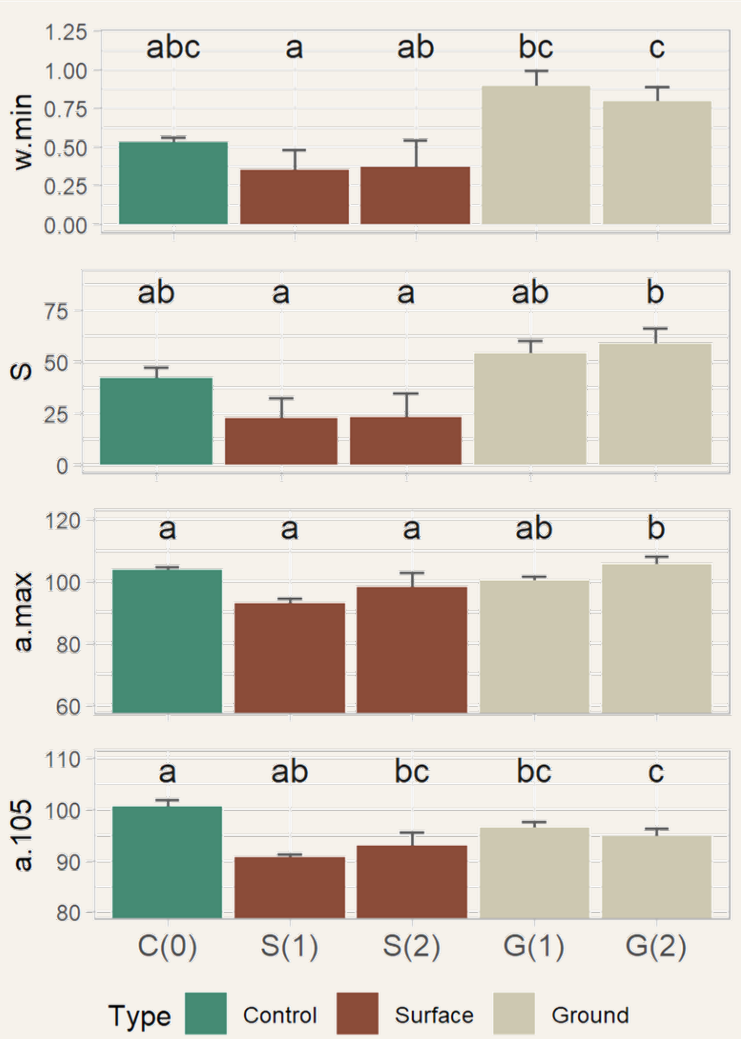
Silandic Andosols

- **Olivares-Martínez, L. D.***, Gómez-Tagle Chávez, A., & Mataix-Solera, J. (**2023**). Ground Fire Legacy Effects on Water-Dynamics of Volcanic Tropical Soils. Spanish Journal of Soil Science: SJSS, 13(1), 17.

Water infiltration thresholds within different fire histories

- Surface vs ground fire (soils with andic properties in temperate forests)
- One and two fires in the last 25 years
- Measurements of field saturated infiltration
- Integrated repellency dynamic index





- **Olivares-Martínez, L. D.***, Gómez-Tagle Chávez, A., & Mataix-Solera, J. (**2023**). Ground Fire Legacy Effects on Water-Dynamics of Volcanic Tropical Soils. Spanish Journal of Soil Science: SJSS, 13(1), 17.

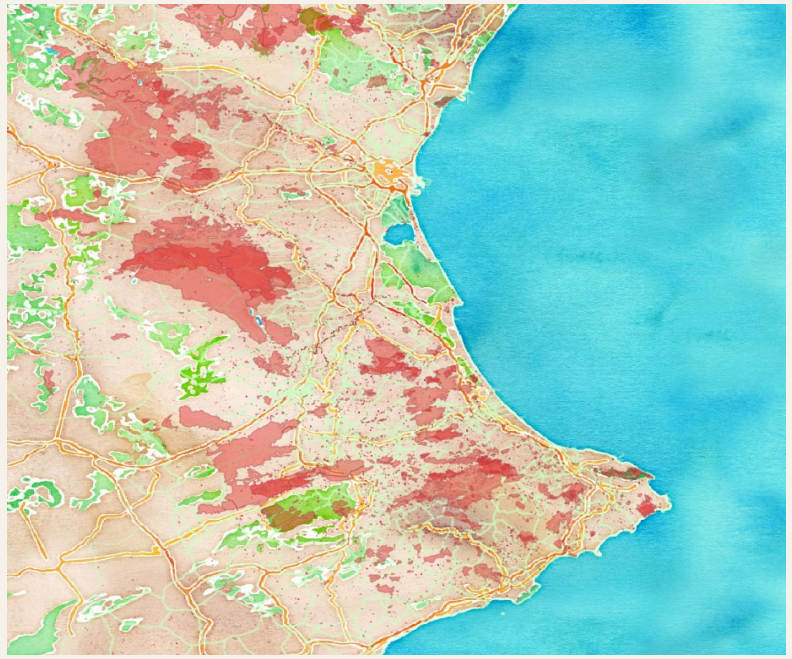
Functional changes in soils burned several times (up to 4 in 50 yrs)

- Mediterranean weather
- Calcareous parent materials
- Forest and shrublands with low-recurrent crown fires
- Composite sampling on the first 5 cm of mineral soil (5 subsampling)

Fire history	n	Plots	Experimental burns
Control	21	7	0
1 fire	21	7	0
2 fires	21	7	0
3 fires	18	7	9
4 fires	18	7	12

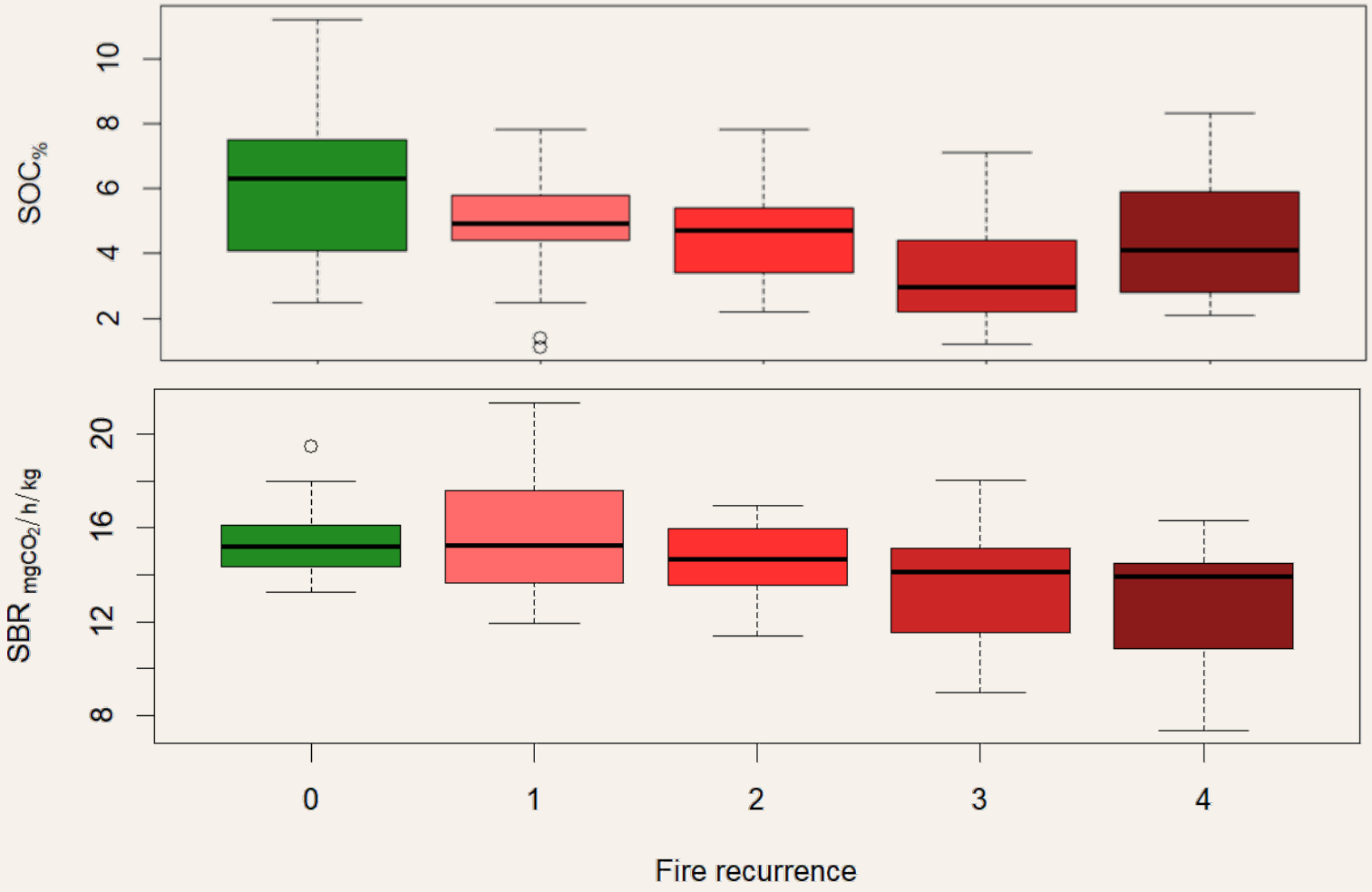
Universidad de Castilla-La Mancha
UCLM
Universitat d'Alacant
Universidad de Alicante

Functional changes in soils burned several times (up to 4 in 50 yrs)

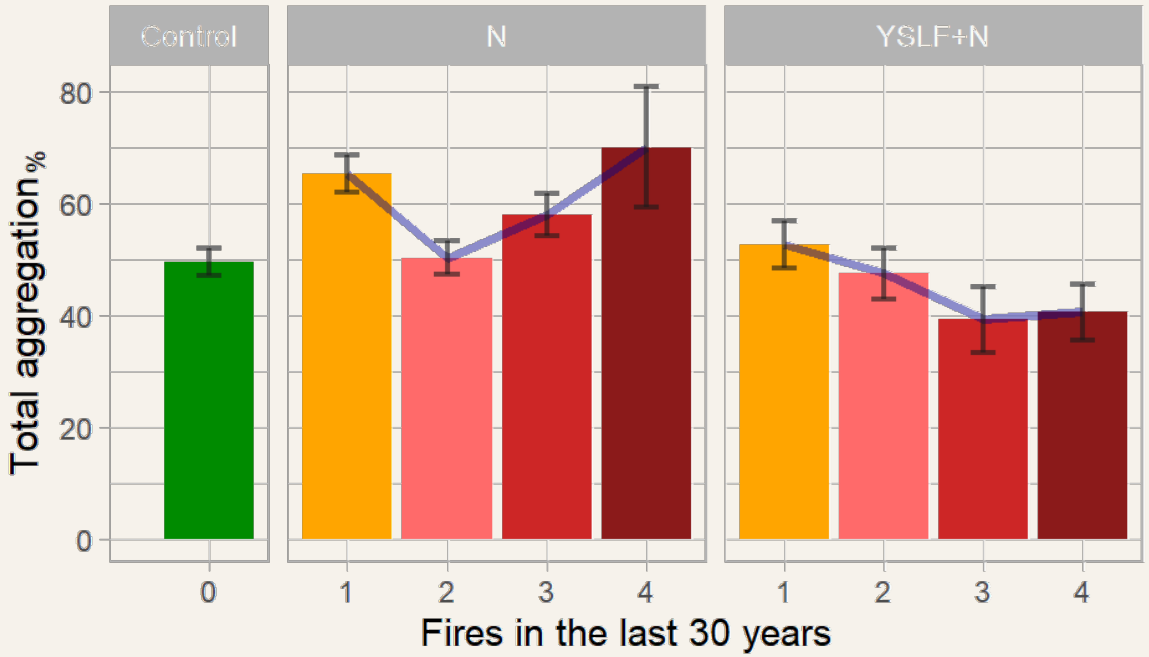


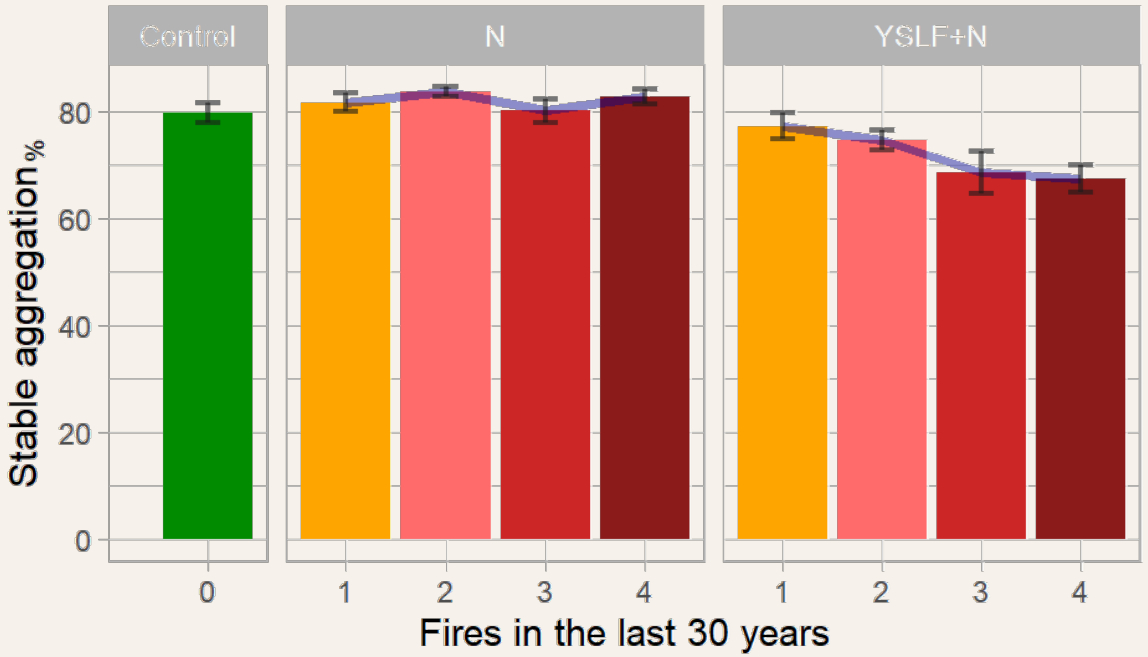
Universidad de Castilla-La Mancha

Universitat d'Alacant
Universidad de Alicante



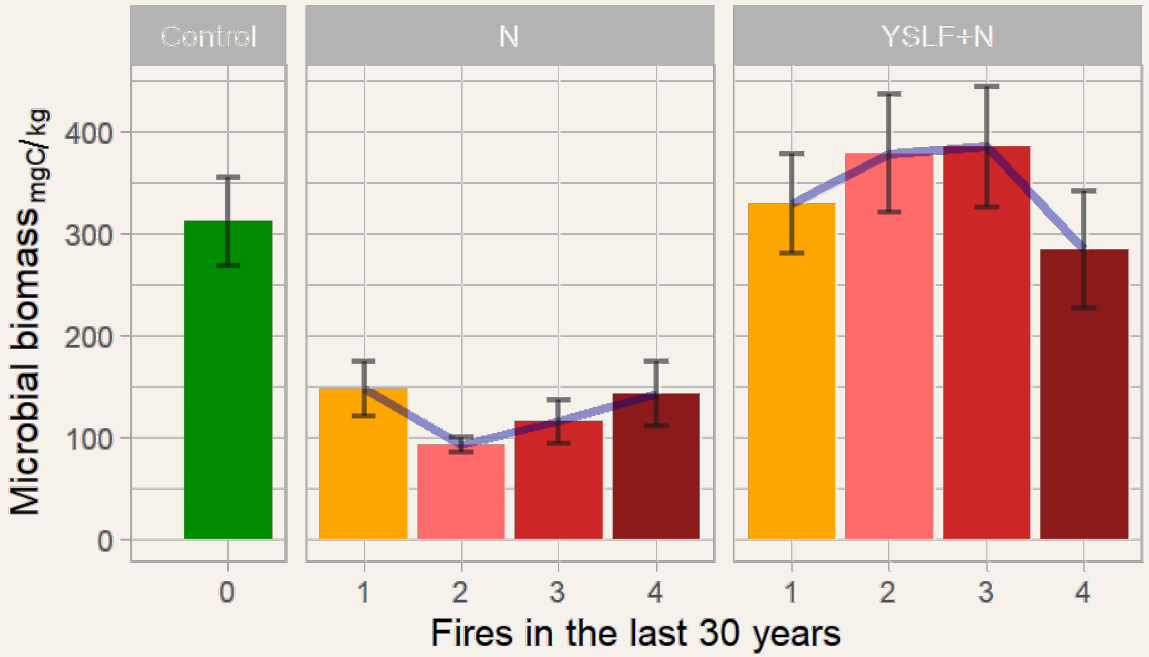
Functional changes in soils burned several times (up to 4 in 50 yrs)

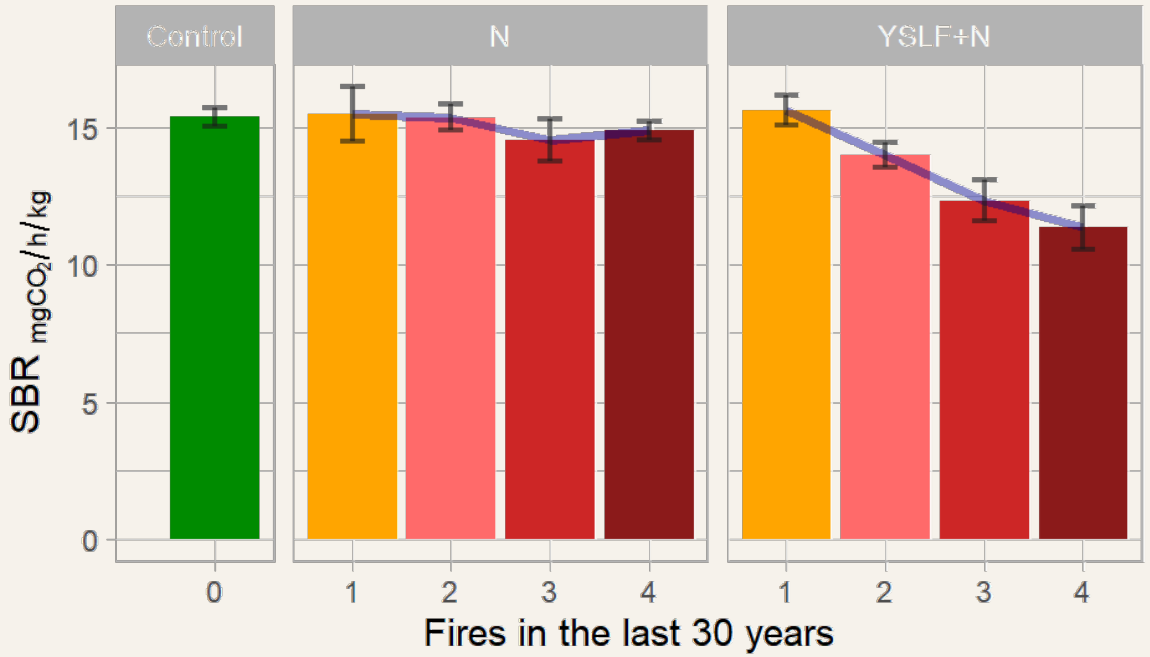




N = Number of fires; YSLF = Years since last fire

Functional changes in soils burned several times (up to 4 in 50 yrs)



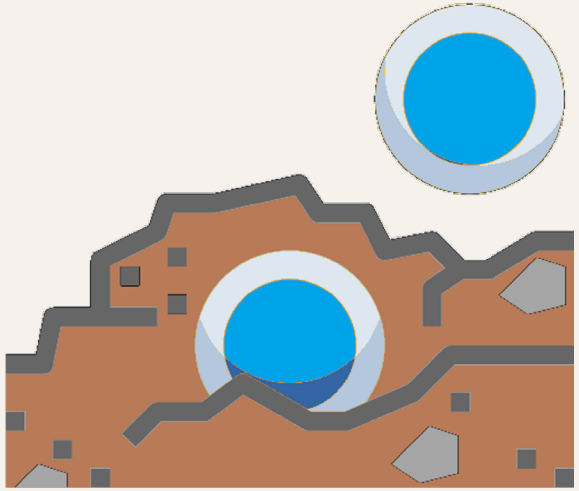


N = Number of fires; YSLF = Years since last fire

Next steps:

Statistical analysis & writing:

- Linear mixed effects models
  - Distinguish between years since last fire and recurrence effects
  - Effectiveness of experimental burns
- Soil water repellency tests (legacy effects?)
- DNA and ELFA analysis (collaboration UCLM)



Another activities:

- ➢ Short stay at TUM Organic matter fractionation (Just et al., 2021) during July 2024
- ➢ PhD Volunteer in Uganda Soil health low-cost assessments with local farmers during September to December 2024
- ➢ SOILGUARD manuscript Monitoring water storage capacities under two climate stressors for seven European productive lands. TOMST sensors data management.

SOILGUARD

Thank you
for your attention

Doubts, questions, suggestions?

ONGOING RESEARCH
Email: lolivares@umh.es
(also available on RG and LinkedIn)