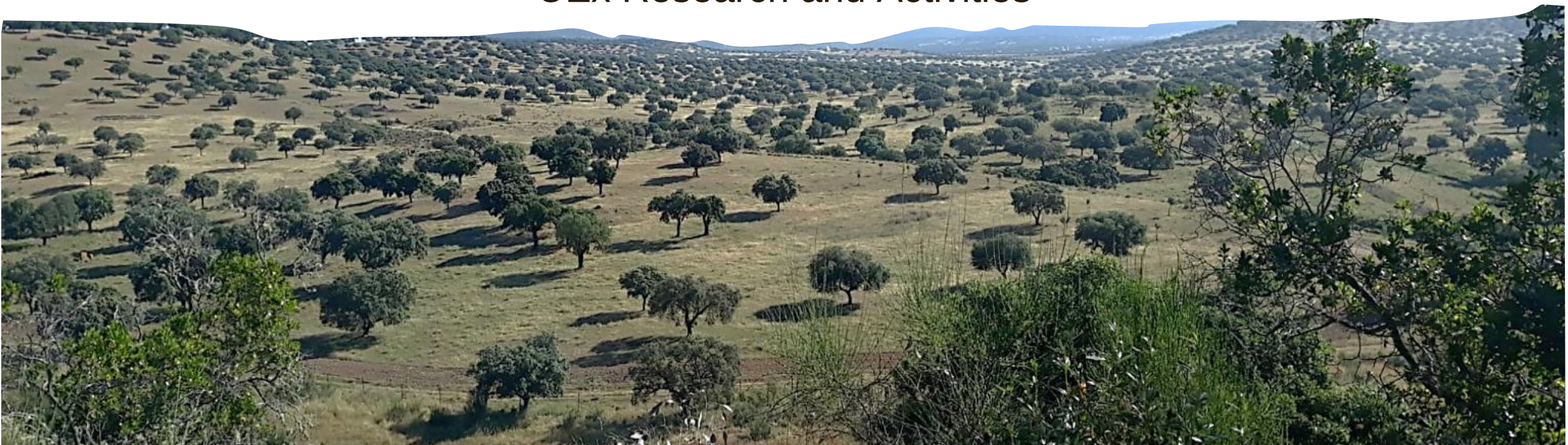
Majadas Workshop 2025

March 27-28, Madrid

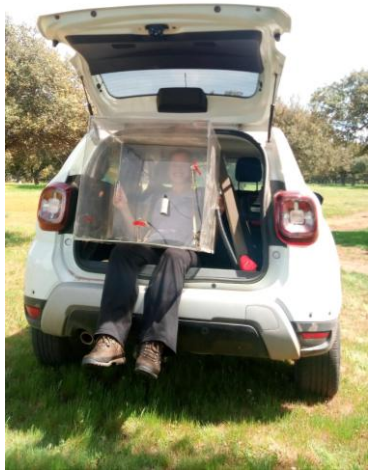
UEx Research and Activities



UEx Research Team

UNIVERSIDAD DE EXTREMADURA



in+dehesa

Instituto de Investigación de la Dehesa

Long-term field campaigns Majadas

Tree LAI

Pasture Production

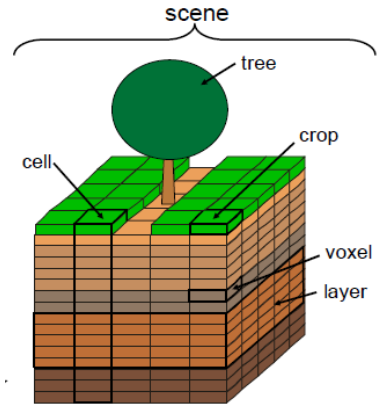
Biodiversity

2015

2024

On-going Research

1. AF tree densities and open pastures simulated



Dupraz et al 2021

100 trees ha^{-1}

50 trees ha^{-1}

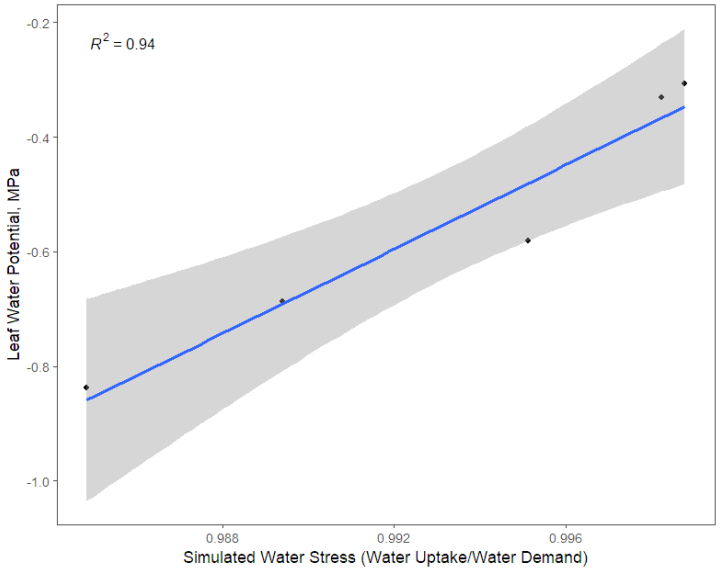
25 trees ha^{-1}

Treeless

Forest

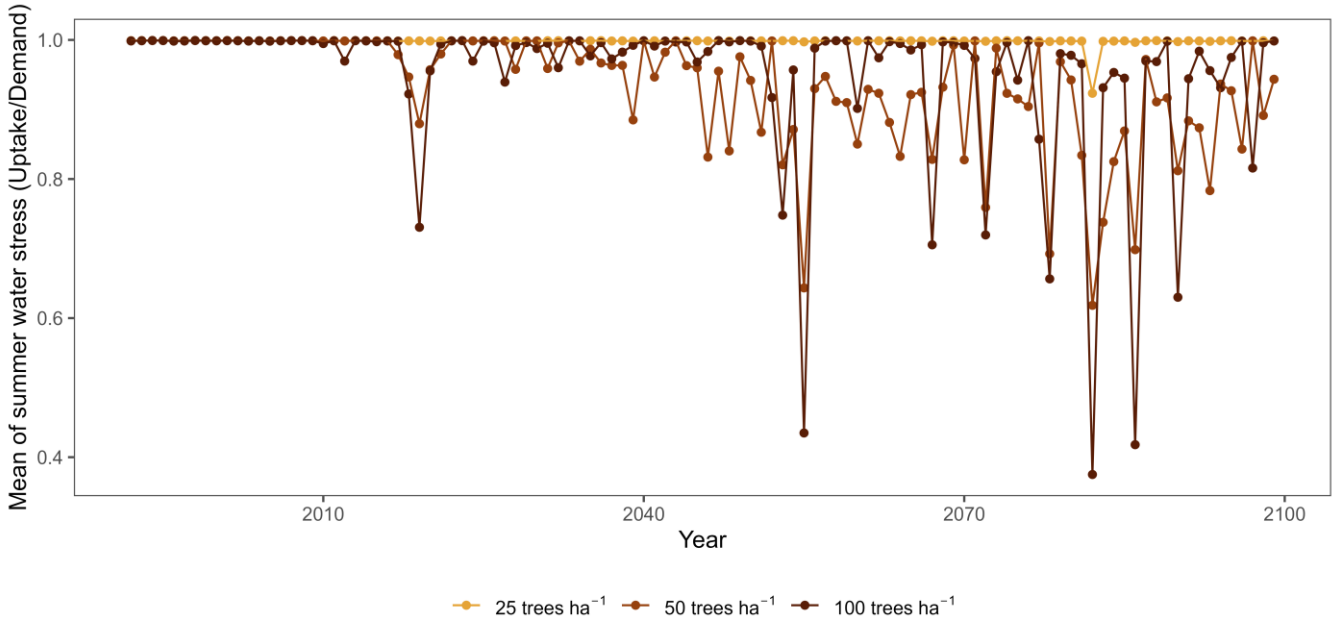
AF

Grassland

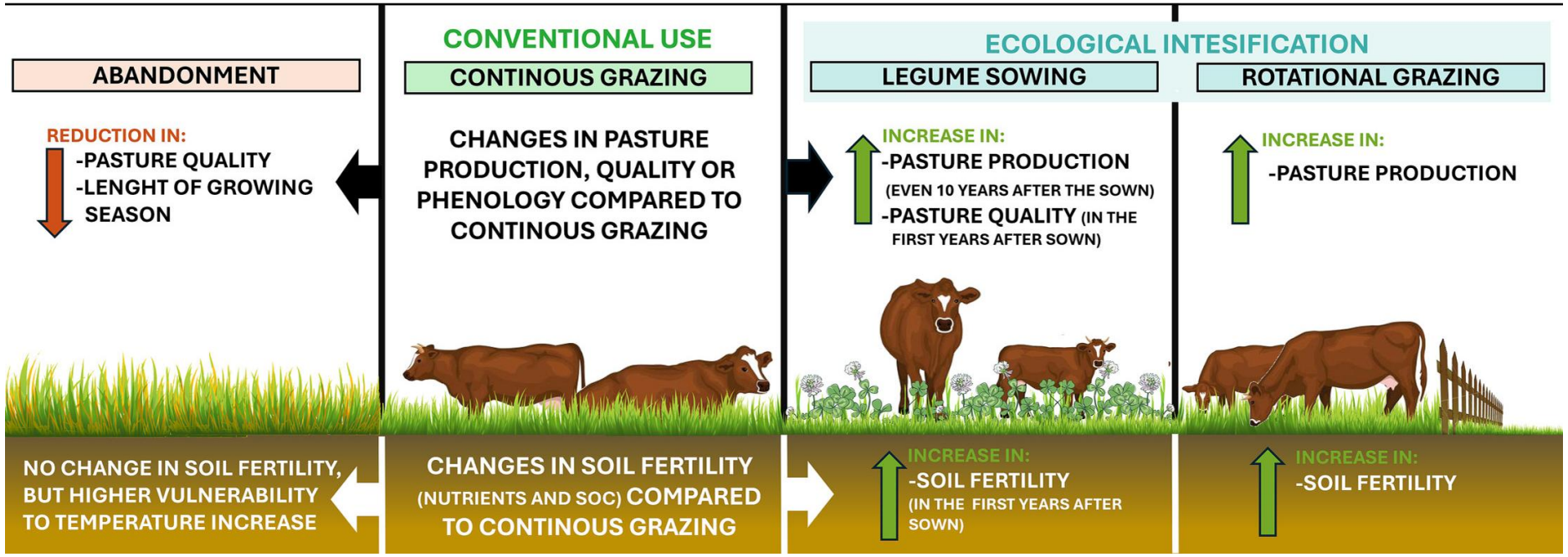


2. Simulation 1990-2100, RCP8.5 effects on:

Plot	Ecosystem services
Tree	Growth, Water stress
Pasture	Production, Stability & Resilience



Ongoing Research

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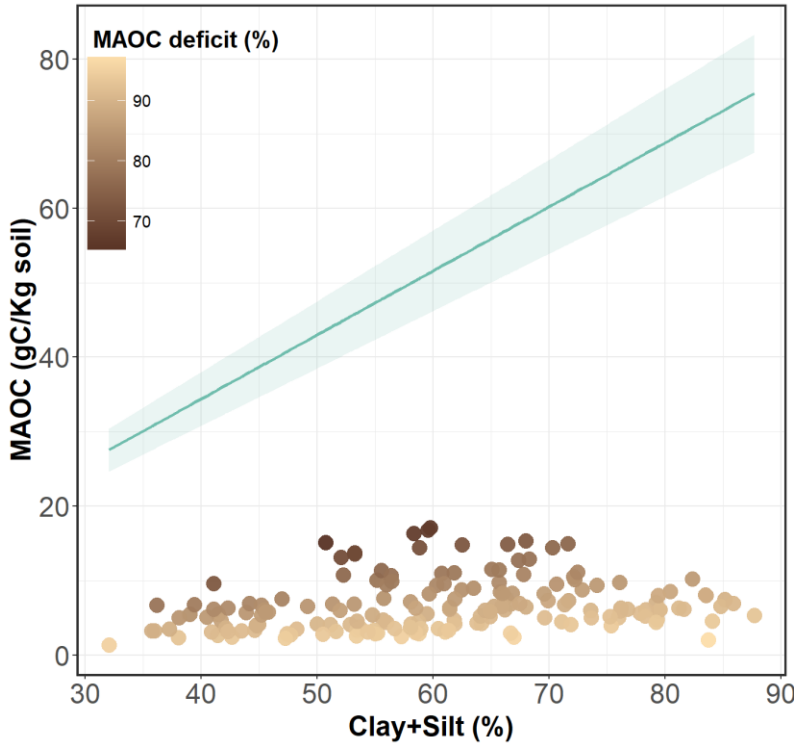
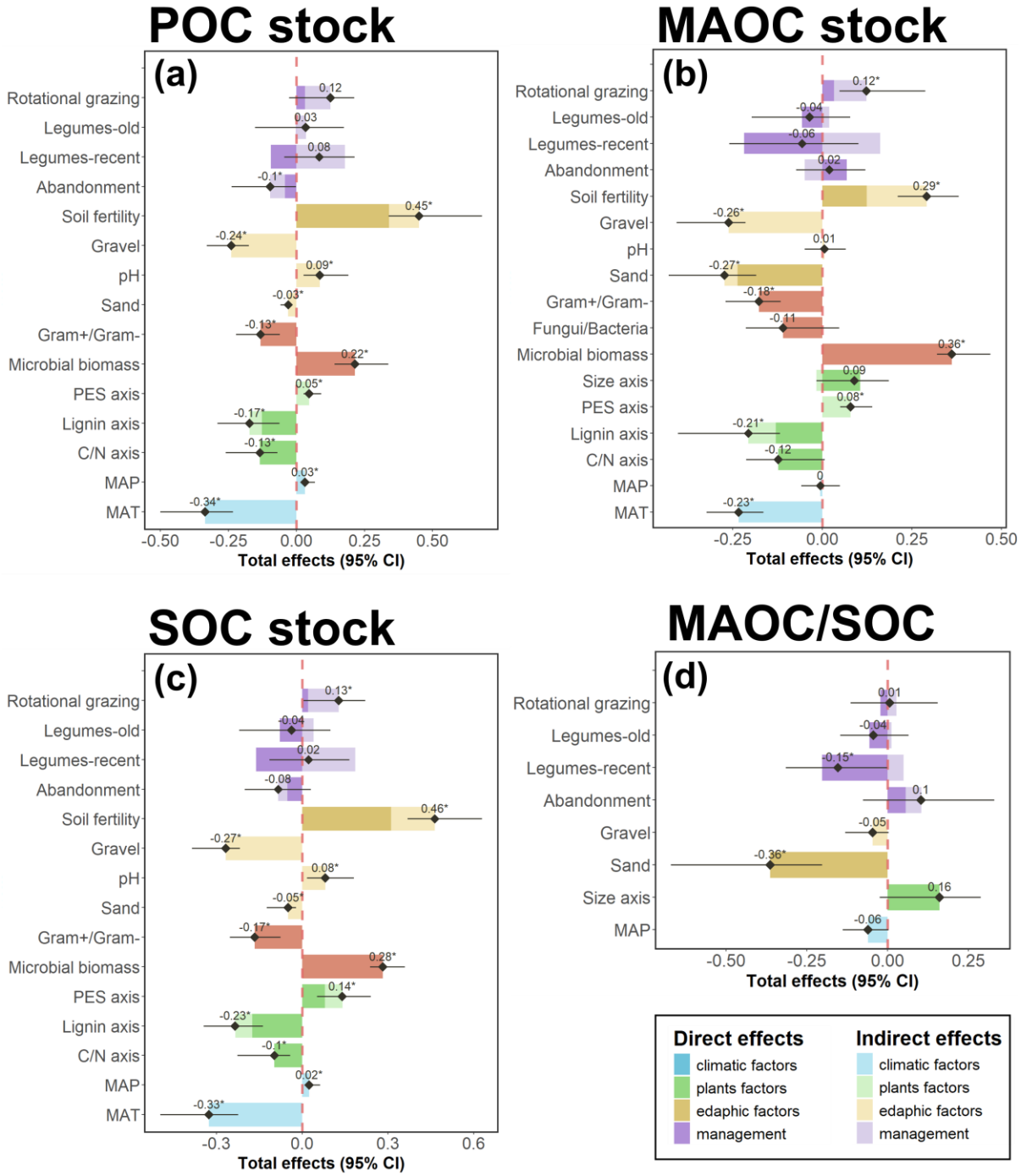
Carrascosa et al., 2024, *STOTEN*

On-going Research

Carbon Fractions

Evaluate changes in vegetation characteristics and soil microbial communities as possible pathways through which management might indirectly affect SOC stocks



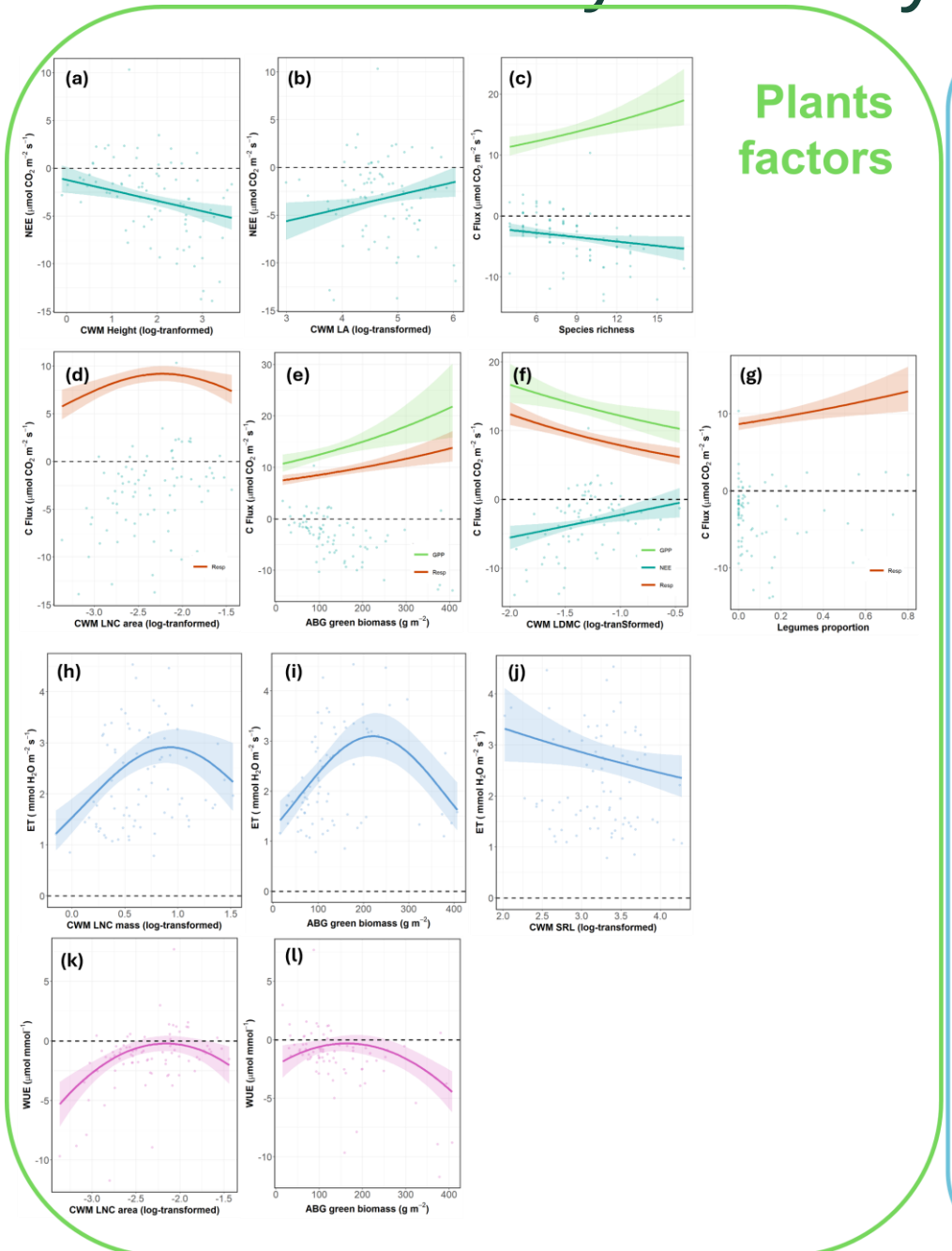


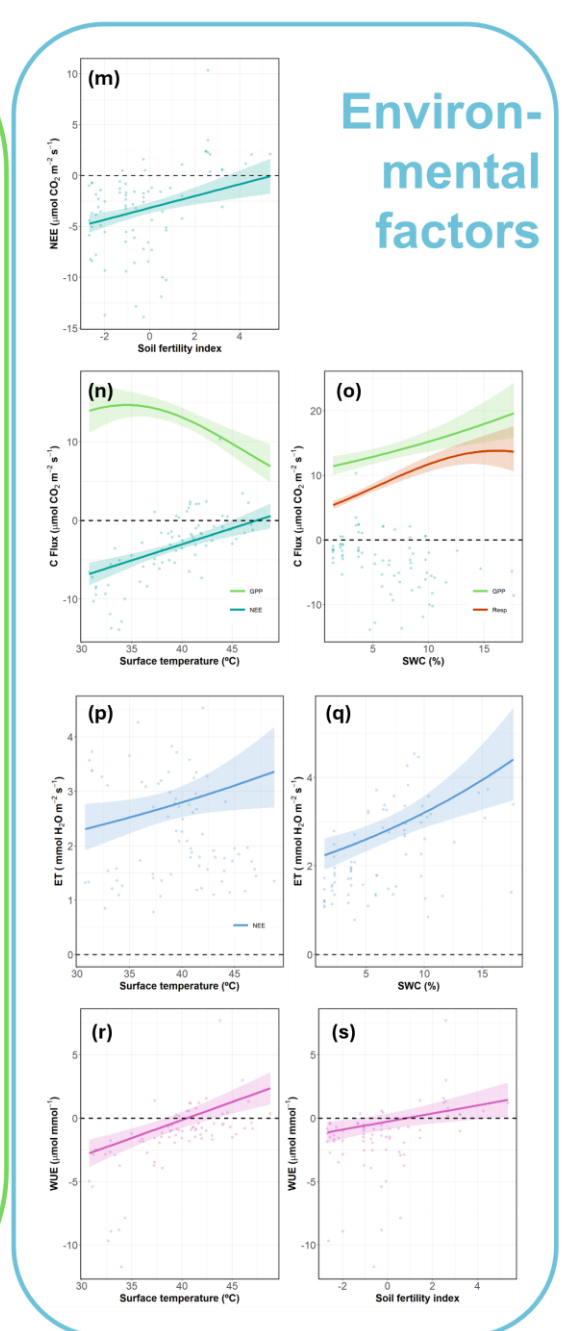
Carrascosa et al., 2025, *submitted GCB*

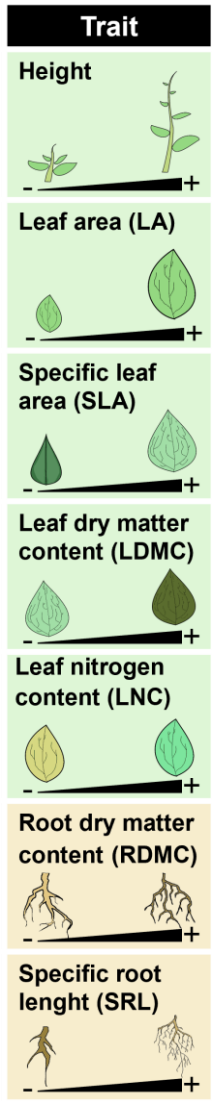
Ongoing Research: Biodiversity – Ecosystem Function

-Three carbon and water fluxes measurement dates (May 2021, 2022 and 2023)

-Species inventories and collection of vegetation traits simultaneous to flux measurements.

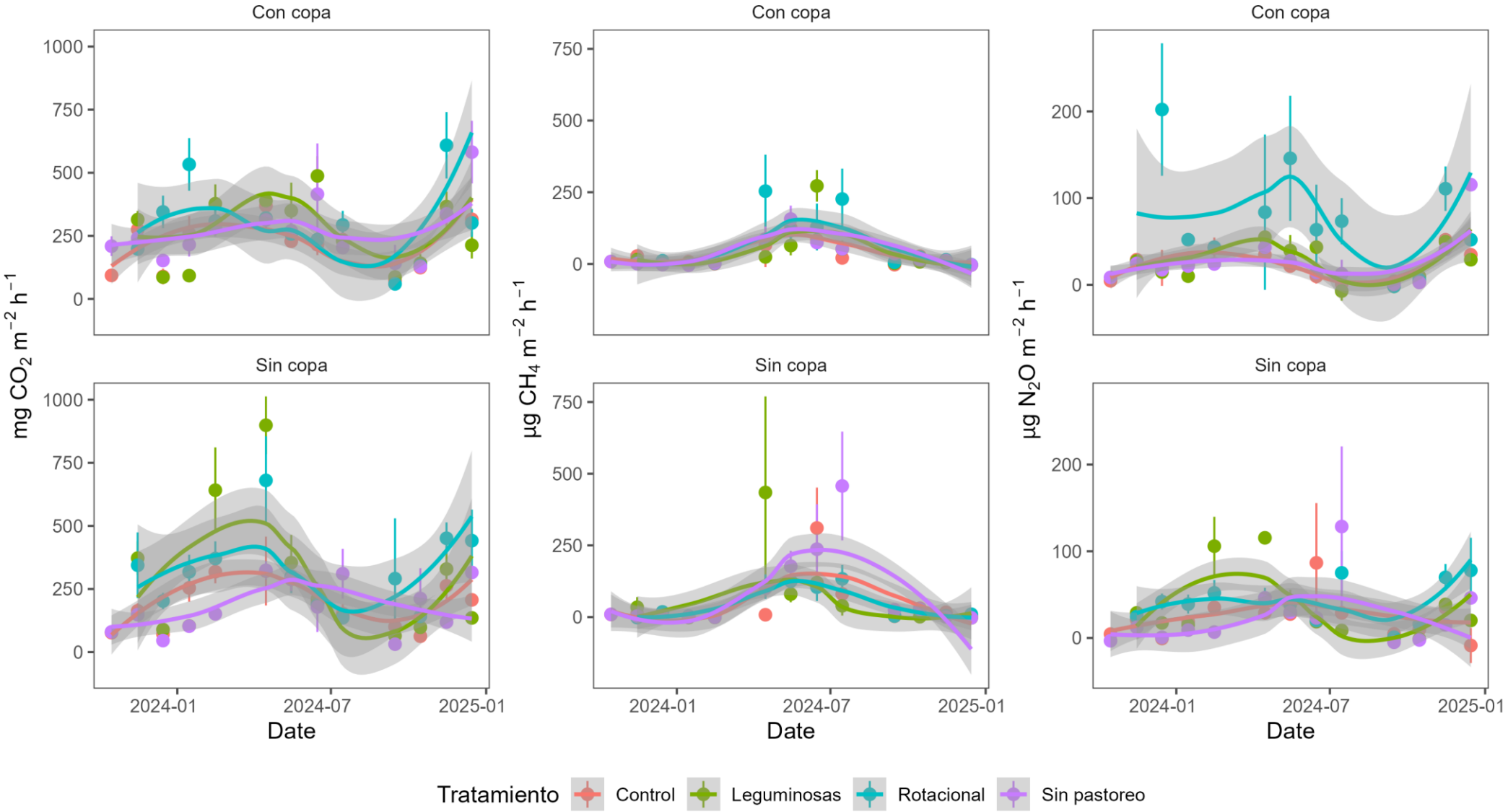






Carrascosa et al., 2025, *in preparation*

On-going Research: GHGs dynamics



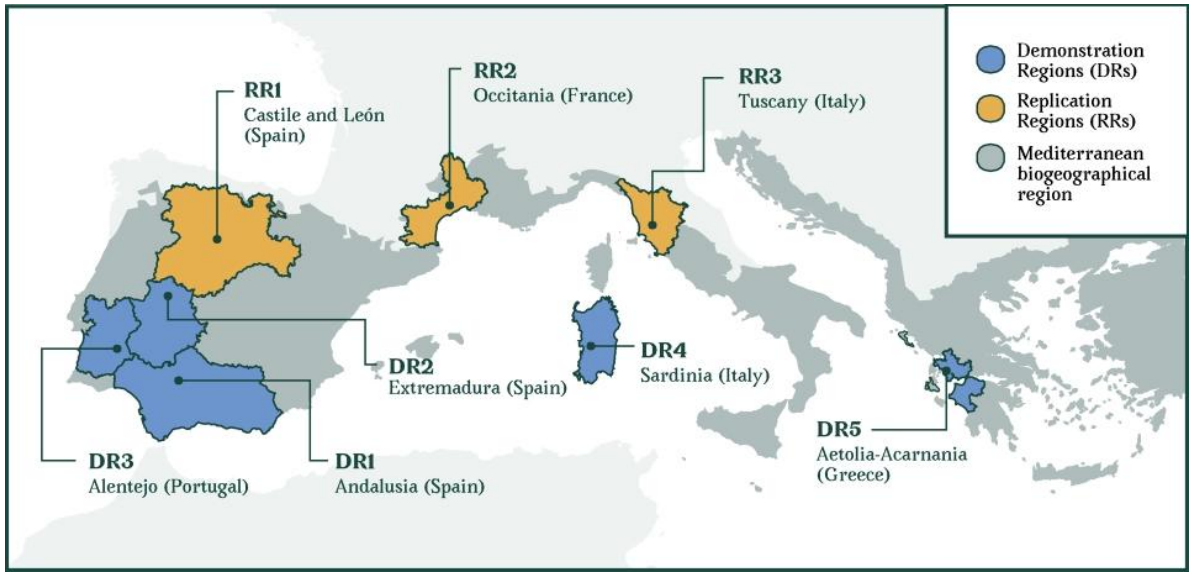
Rey et al., 2025, *in preparation*

Planned activities

DRYAD

The DRYAD project supports the Mission Adaptation to Climate Change by **developing and implementing reallife, climate-resilient nature-based solutions (NBS)** for Mediterranean agrosilvopastoral ecosystems (MAEs).

The proposal will be centered around development, testing and demonstrating **NBSs in 5 demonstration regions including Andalusia and Extremadura (ES), Alentejo (PT), Sardinia (IT) and Aetoloakarnania (EL) (5 in Cohesion** Fund Regions). **The most promising NBSs will be transferred to these 3 replicating regions: Castilla-y-León (ES), Occitanie (FR) and Tuscany (IT).**



Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No GA 101156076

Which NBSs are we talking about

WATER // BIODIVERSITY // SOIL

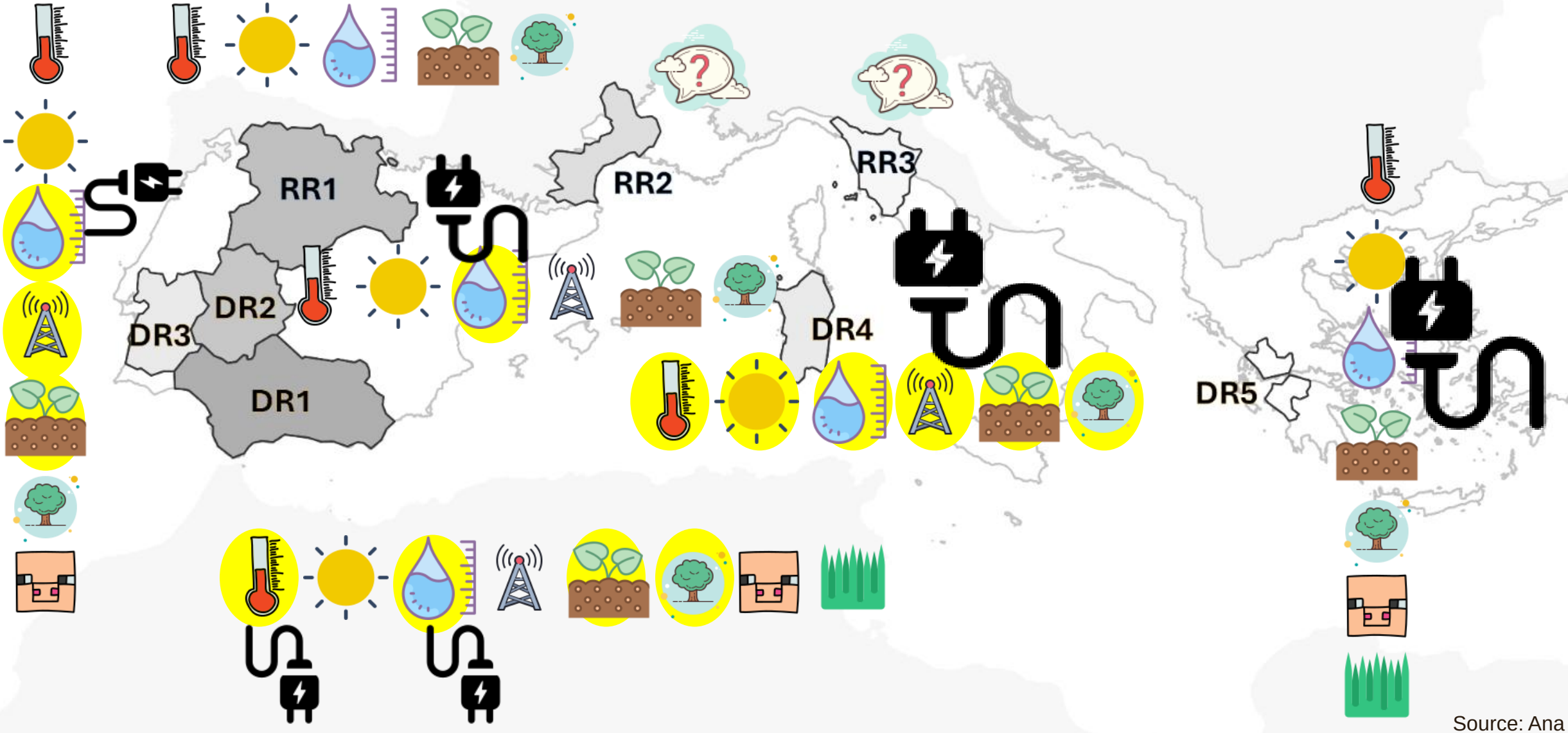
1. **Drainage ditch system**: excavation along contour lines, filled with plant waste from tree pruning and brush clearing.
2. **Dry dam** (water retention during periods of greatest rainfall): retention and storage infrastructure to promote deep infiltration.
3. **Artificial ponds** (ponds): ponds in contact with the saturated water level of the soil, so that water is available all year round.
4. **Improving water quality**: practices to prevent deterioration of the quality of water bodies, including the use of vegetation to protect and purify pollutants, the use of perimeter fences and the placement of artificial fountains.

5. **Natural islands**: creation and maintenance of several natural islands (bushes, ponds, wooded areas) that serve as a refuge for wild animals and increase biodiversity.
6. **Planting in protected places with bushes**: planting trees and bushes in protected places to preserve the organic carbon content in the soil and improve water retention in the soil.
7. **Protection of trees and bushes**: reconciling grazing with the protection of trees through temporary shelters and fences.
8. **Early detection of tree mortality**: on-site assessment of tree health and mortality using specific sensors, multispectral images acquired by drone, ecological models and composite risk indices OR UCO OAK DECLINE MODEL

9. **Real-time livestock monitoring**: use of collars with sensors to monitor livestock in real time (via the LoRaWan system).
10. **Adaptive grazing management:** adaptive grazing practices to improve soil health.
11. **Biochar**: use of charcoal to increase soil water retention.
12. **Biodiverse grassland planting**: planting diverse, legume-rich grasslands to improve vegetation cover without tillage.
13. **Afforestation of agricultural land and pasture**: planting scattered trees and shrubs in open areas (on agricultural land and non-wooded pasture) to increase soil carbon content and improve the water cycle.

List of sensors

Lorawan



Source: Ana Andre

Models and minimum requirements

MODFLOW | STEMUS-MODFLOW | STEMUS-SCOPE-MODFLOW

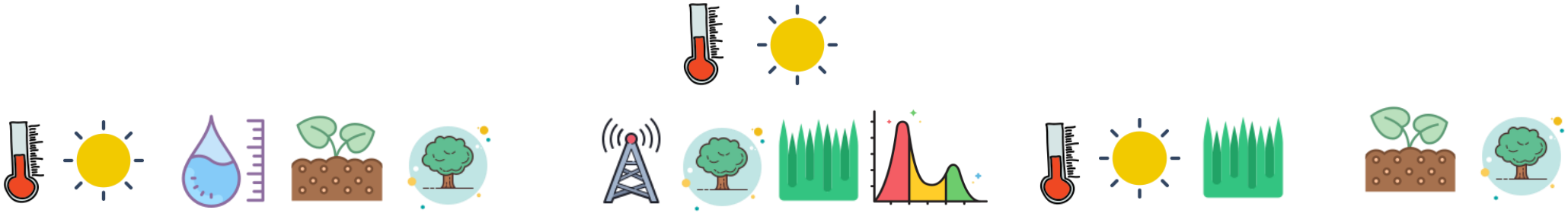
Groundwater

Chlorophyll & Bunch leaf properties

Spectral information

Soil properties

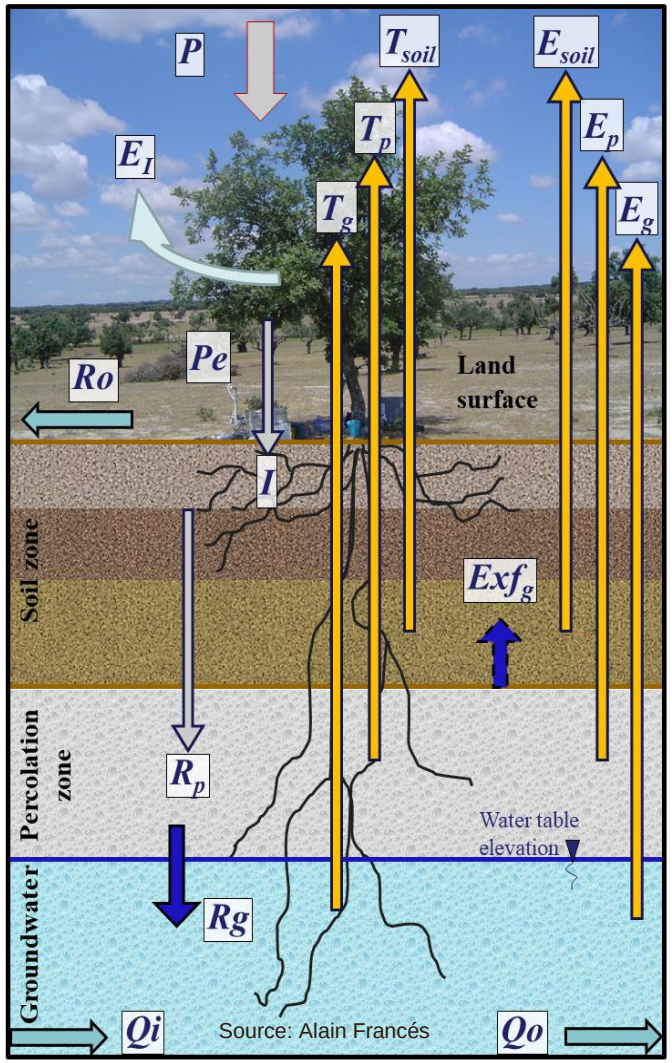
WIMMED

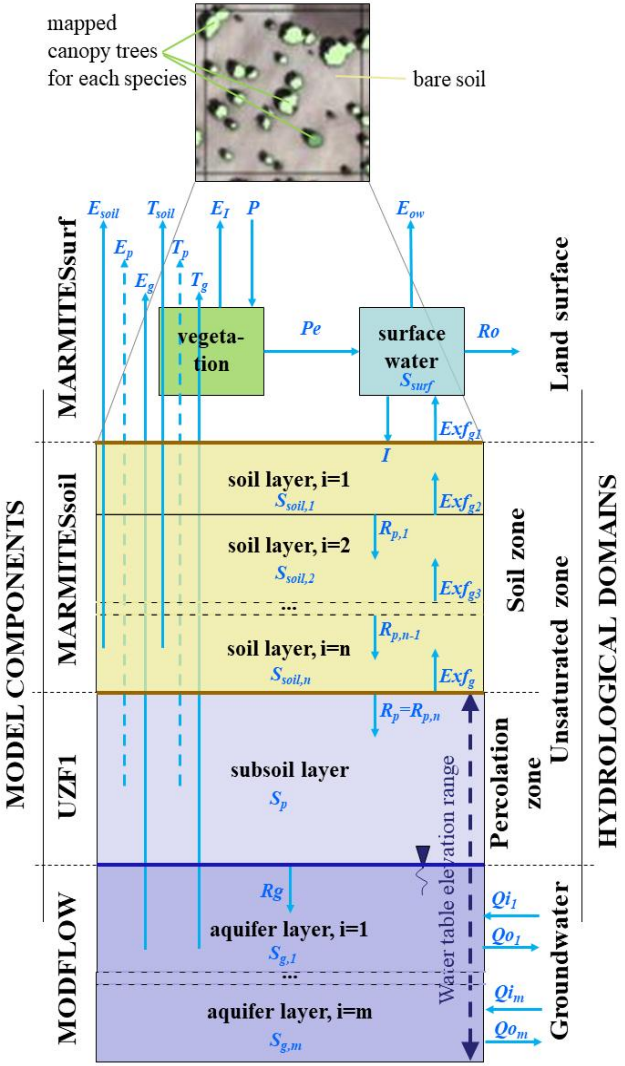


YIELD-SAFE | HI-SAFE | ET-RS | LUE | FLAPMAP | OAK-DECLINE

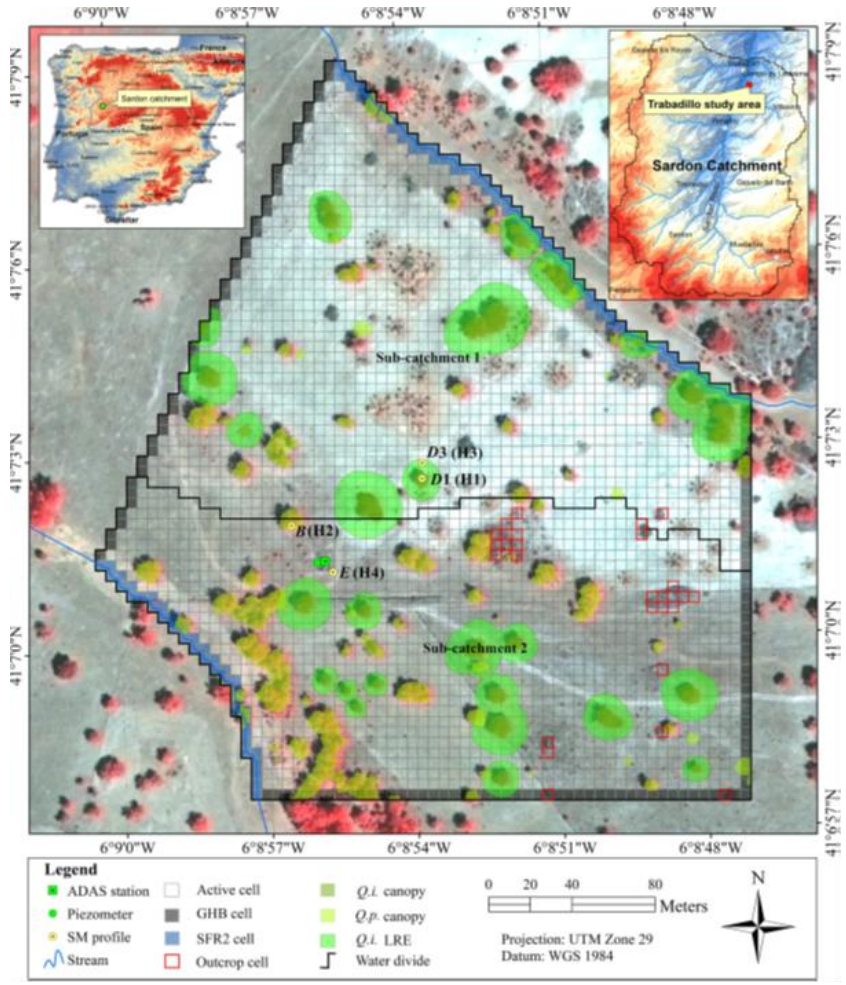
Source: Ana Andreu

Integrated Hydrological Model: MODFLOW6





Sardon Catchment

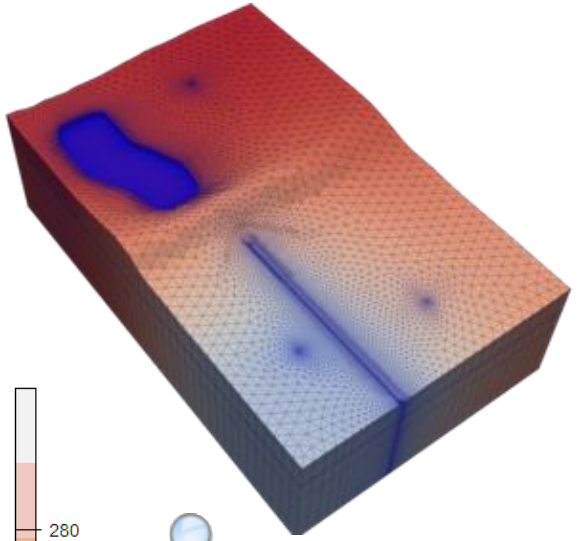


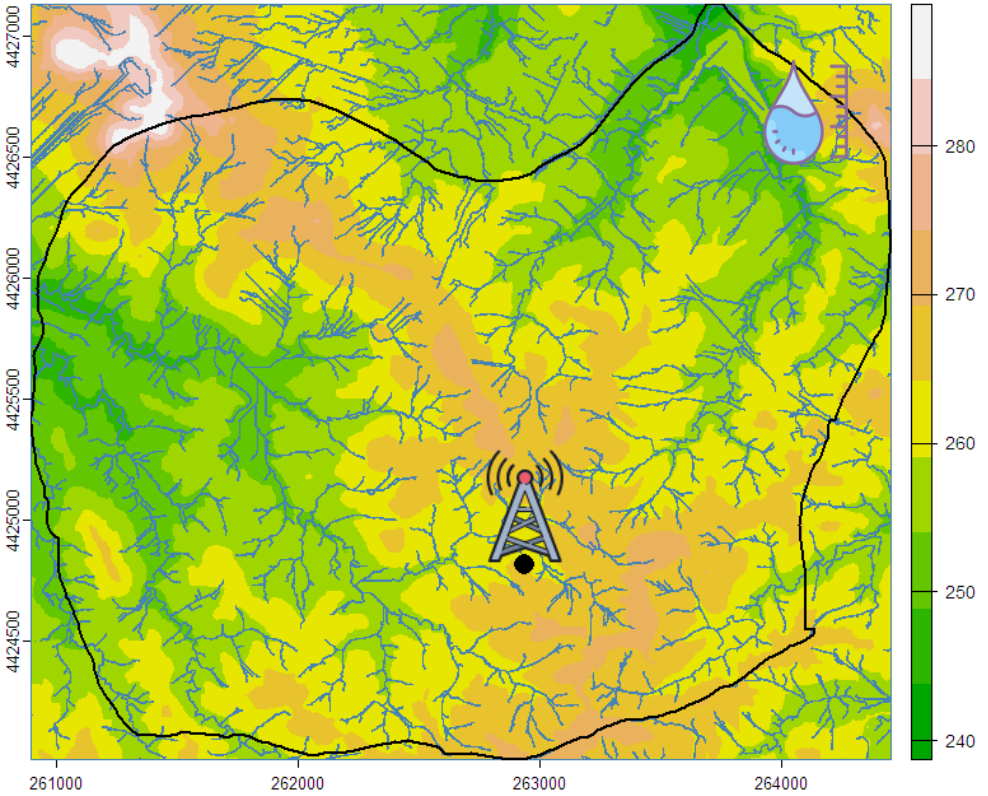
Hassan, (2024) Journal of hydrology

Requirements

Calibration against observations:

- Hydraulic heads
- Stream flows
- Soil moisture
- Matric potential
- RS evapotranspiration

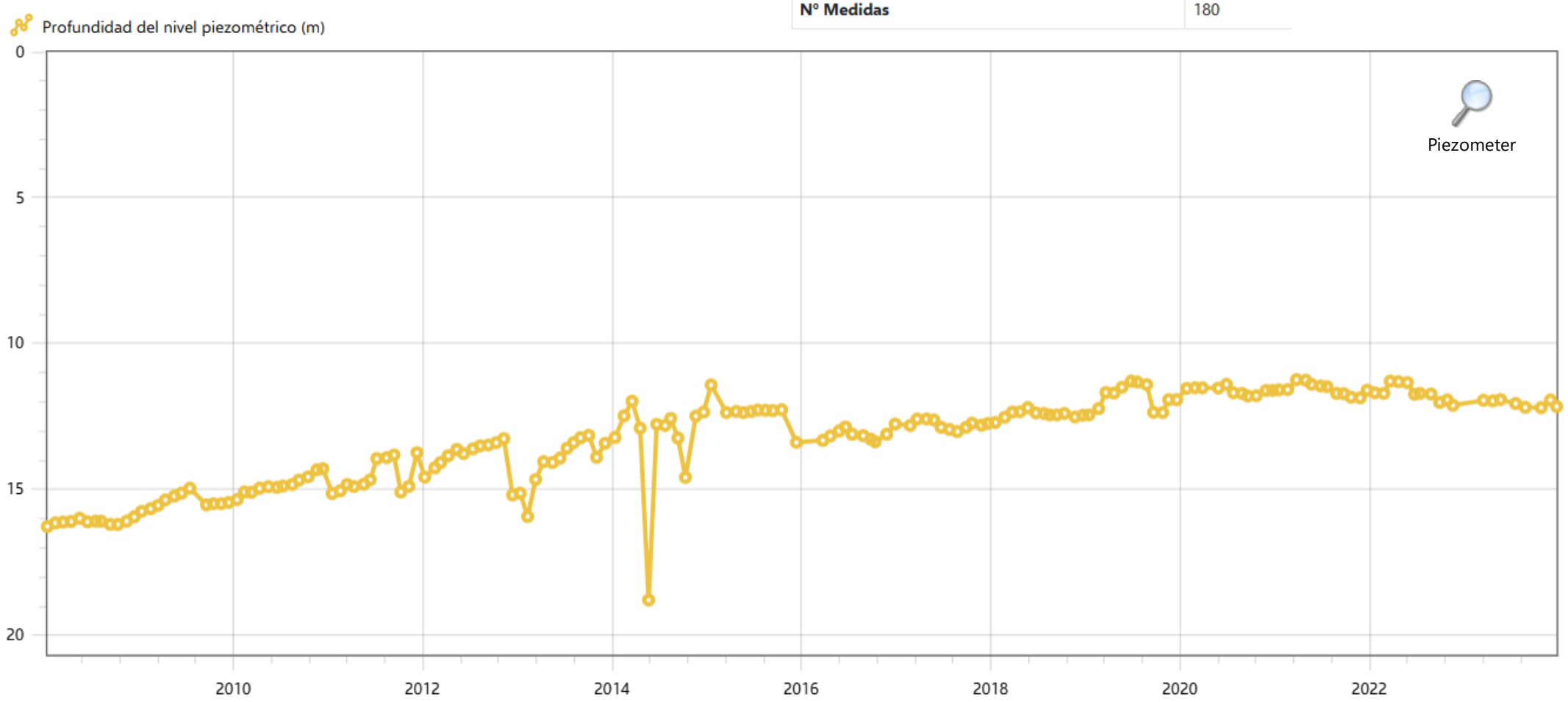




Piezometer

Piezometer Majadas CHT

Profundidad obra (m)	168
MASb controlada	Tiétar
Provincia	Cáceres
Municipio	Majadas
Fecha Nivel	14-12-2007
Nº Medidas	180



Installation of two piezometers

They must comply with ICOS standards

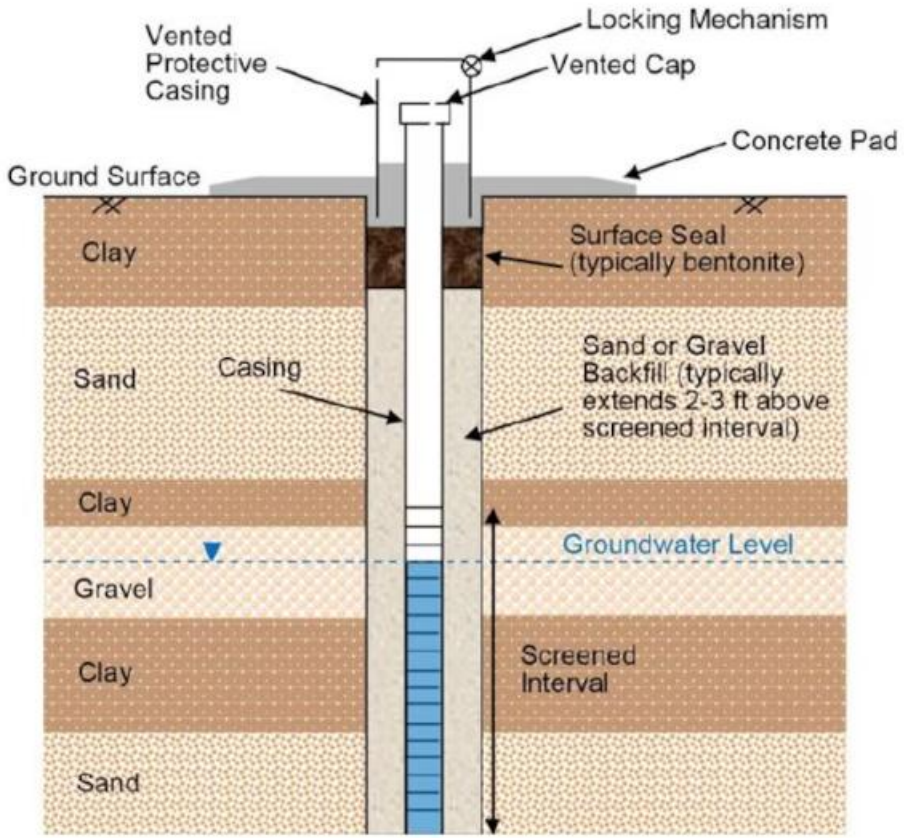
Pressure transducer

Pressure transducers must meet the following specifications:

- gauged, i.e. equipped with a vent tube to compensate for atmospheric pressure changes
- measurement accuracy ≤ 0.5 cm, as indicated on the specification sheet (derive this from % Full Scale and the selected Full Scale – see below).
- measurement range exceeding the expected maximum height of the water column above the installed transducer (select a proper Full Scale – see below).
- equipped with a communication cable for instant data transfer to data loggers (no divers allowed).
- designed for long-term submersion.

Full Scale is the measurement range for which the transducer is calibrated in the factory. For any given model you can usually choose between several Full Scales, e.g. from 0 to 2 m (= 0 to 20 kPa), from 0 to 5.1 m (= 0 to 50 kPa), etc. If you choose a Full Scale of 0 to 5.1 m for a transducer with an accuracy of 0.05% Full scale, its accuracy in cm is (0.05/100) x 5.1 m ≈ 0.26 cm.

All measurements at an ecosystem station must be done with the same transducer model.



Which depth?

Location?

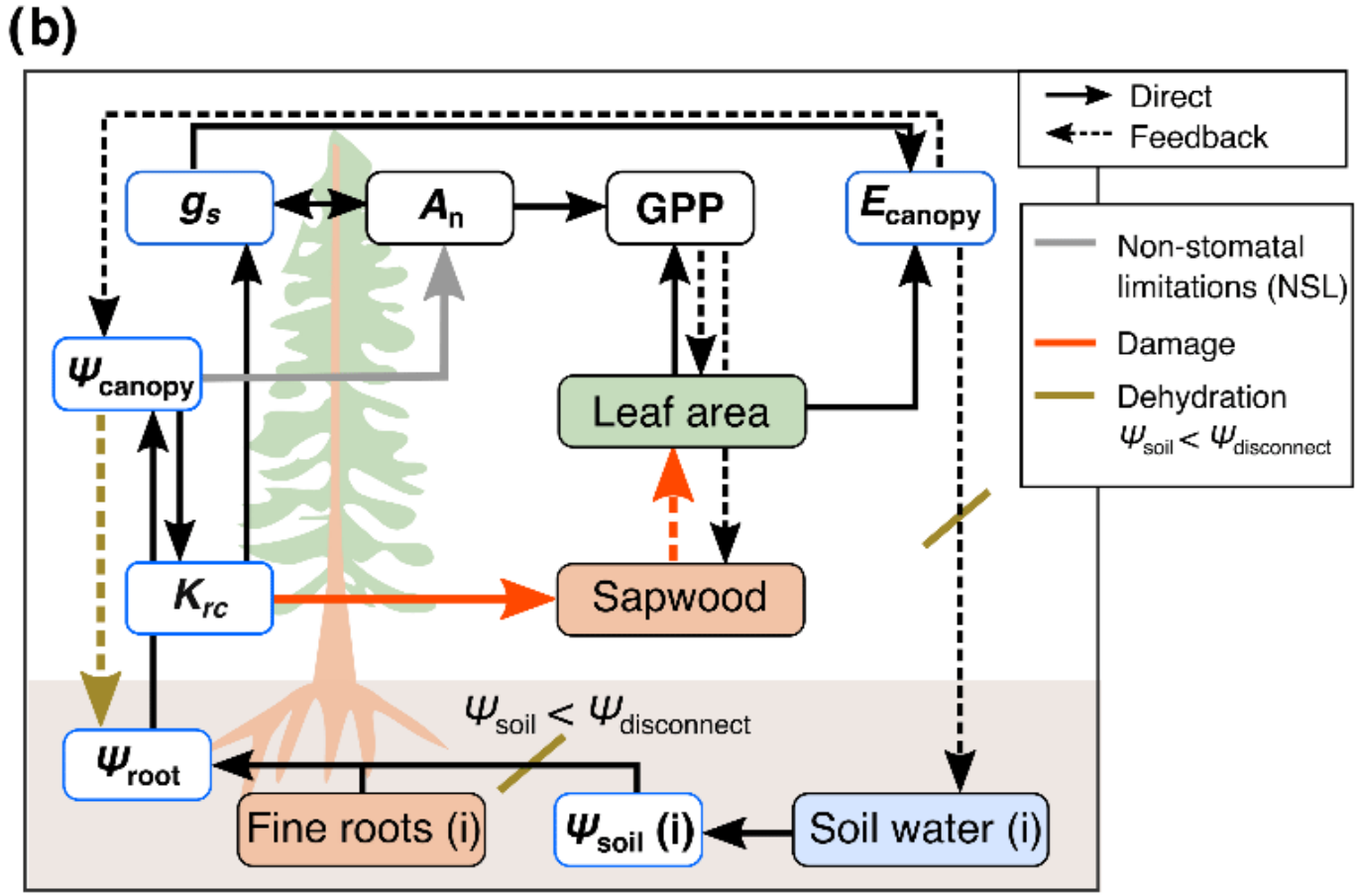
±0.05% full-scale-range

Installation of soil water potential sensors

Reinforce existing installation of sensors

Soil water retention curves

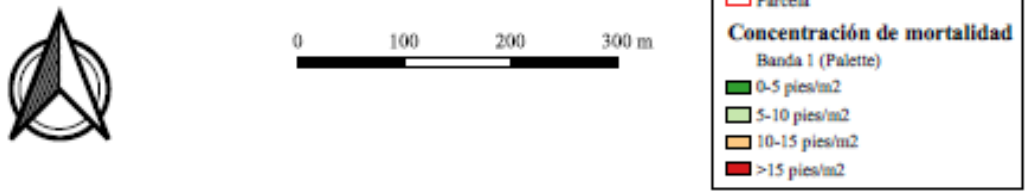
Improve models to predict response to drought



Nadal-Sala et al., 2024, *Biogeosciences*

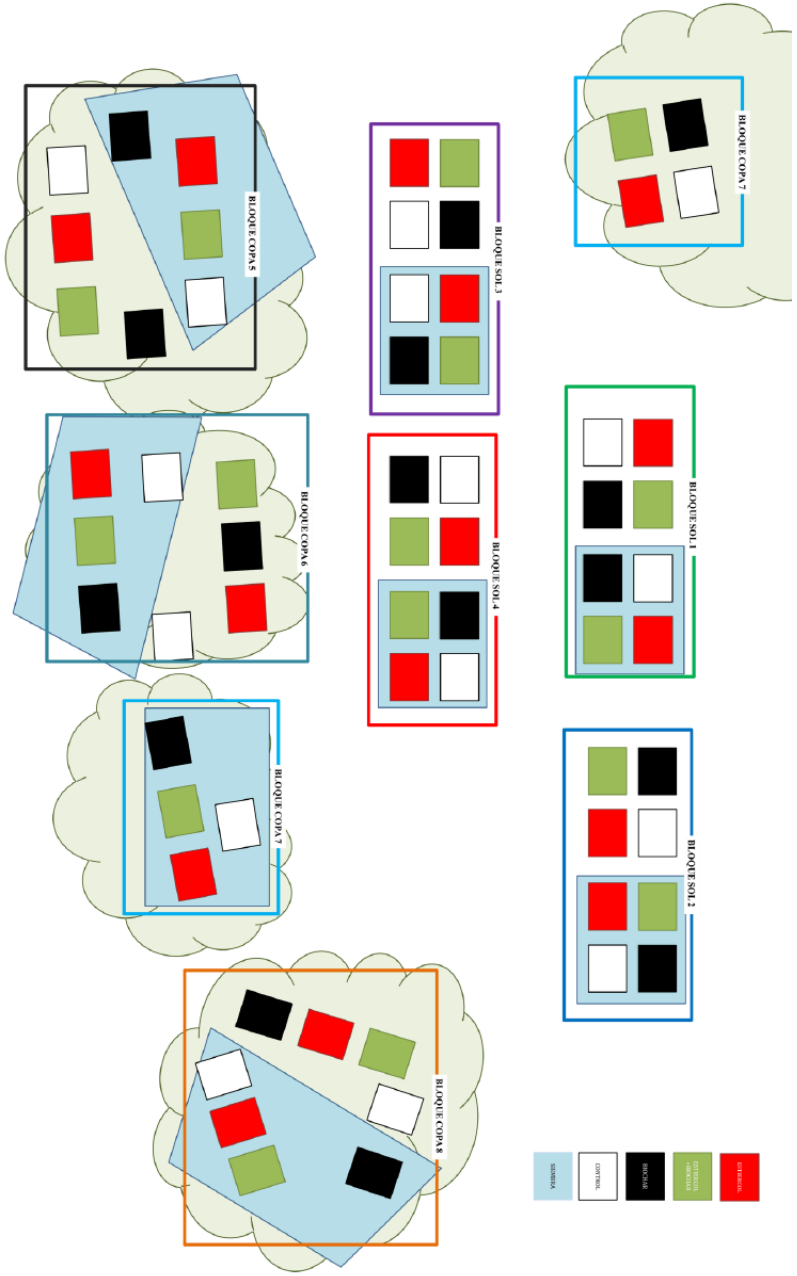
Tree decay spread

1. Establishment of LoRaWan network in Majadas farm to monitor soil water dynamics
2. Spread of tree decline
3. Validation of Hydrological model or spread model (UCO) to assess spread in several locations were tree decline has been mapped.



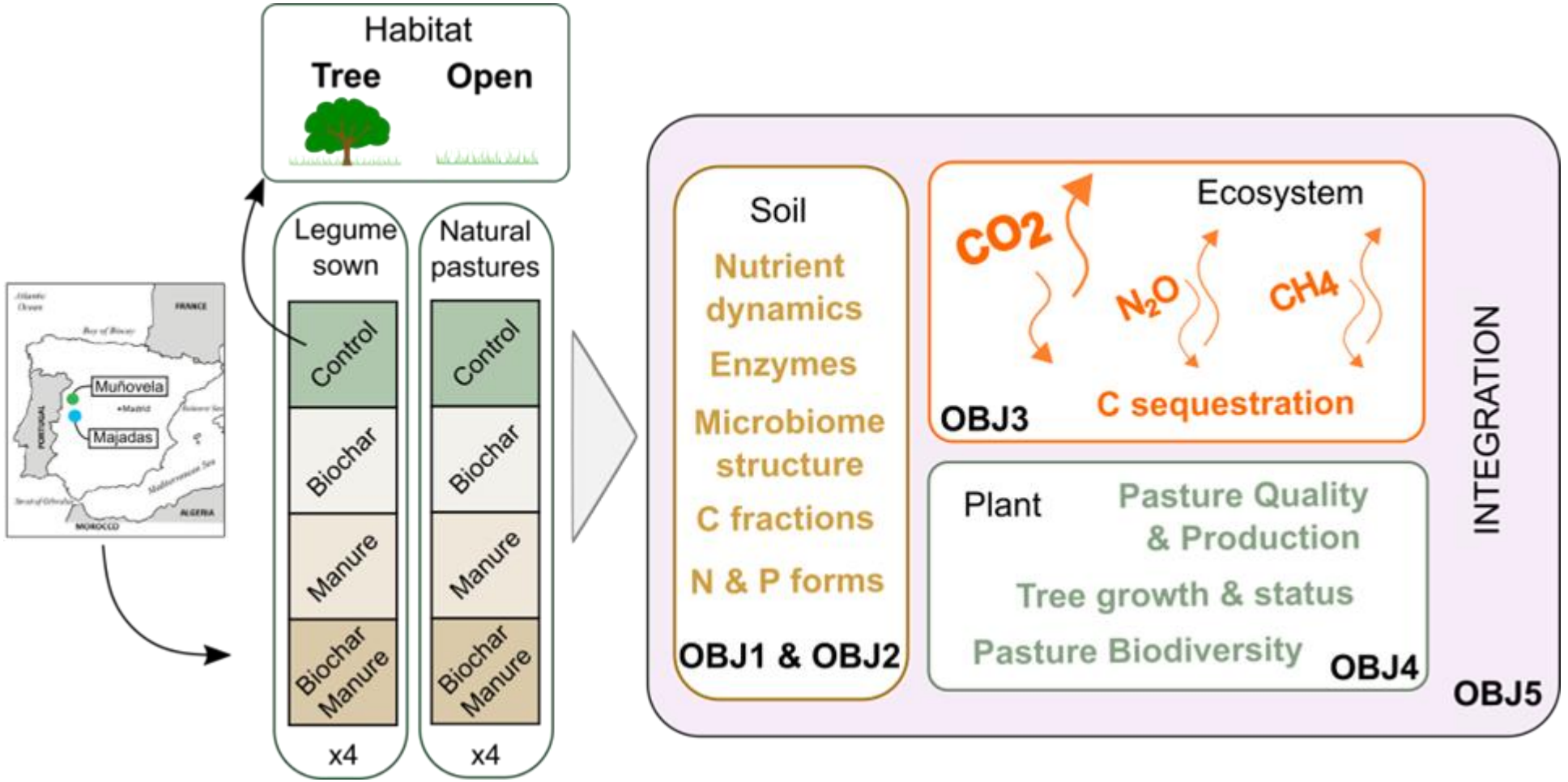
MITIGASMART

Experiment to assess the effect of biochar with compost and legumes



MITIGASMART

1. Dataset on pasture production, quality and soil characteristics for 3 years
2. Modelling using Hi-sAFe and Yield SAFE models (Tasks 3.3)
3. Soil moisture and meteo station with LoRaWan.



THANKS