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Changes in soil organic matter after 5-year field experiment of rainfall exclusion and increased temperature in a Mediterranean savannah

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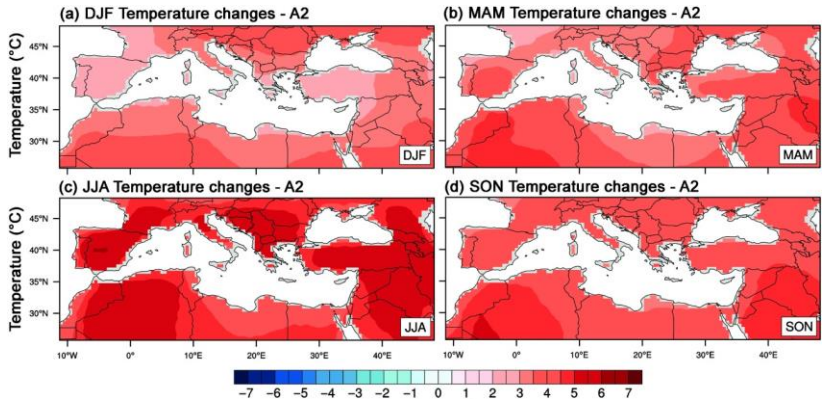
Introduction



Ozturk *et al.*, 2015

These Mediterranean ecosystems are subjected to a marked seasonality that imposes a sever summer drought after a favourable rainy autumn and spring, that is reflected in soil microbial dynamics, especially given forecasted extreme climatic events (IPCC, 2013).

Mediterranean savannas are typical agro-sylvo-pastoral systems, characterized by the scattered presence of oak trees (*Quercus ilex*, *Quercus suber*), and the integration of livestock, forest and agricultural practices.

Experimental design

- Soil samples were taken from the 10 uppermost cm of soil in an experimental plot located in Pozoblanco (Córdoba, SW Spain).
- Data presented correspond to sampling conducted in **2017** (a year after the installation of field trials) and five years later in **2021**.

Two habitats:

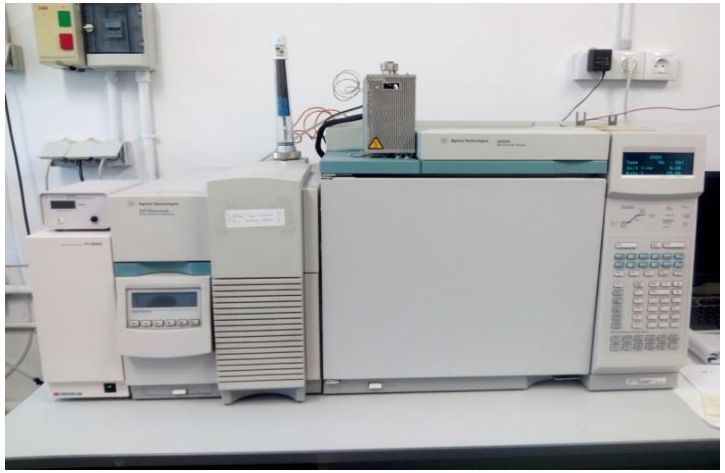
Tree

Open

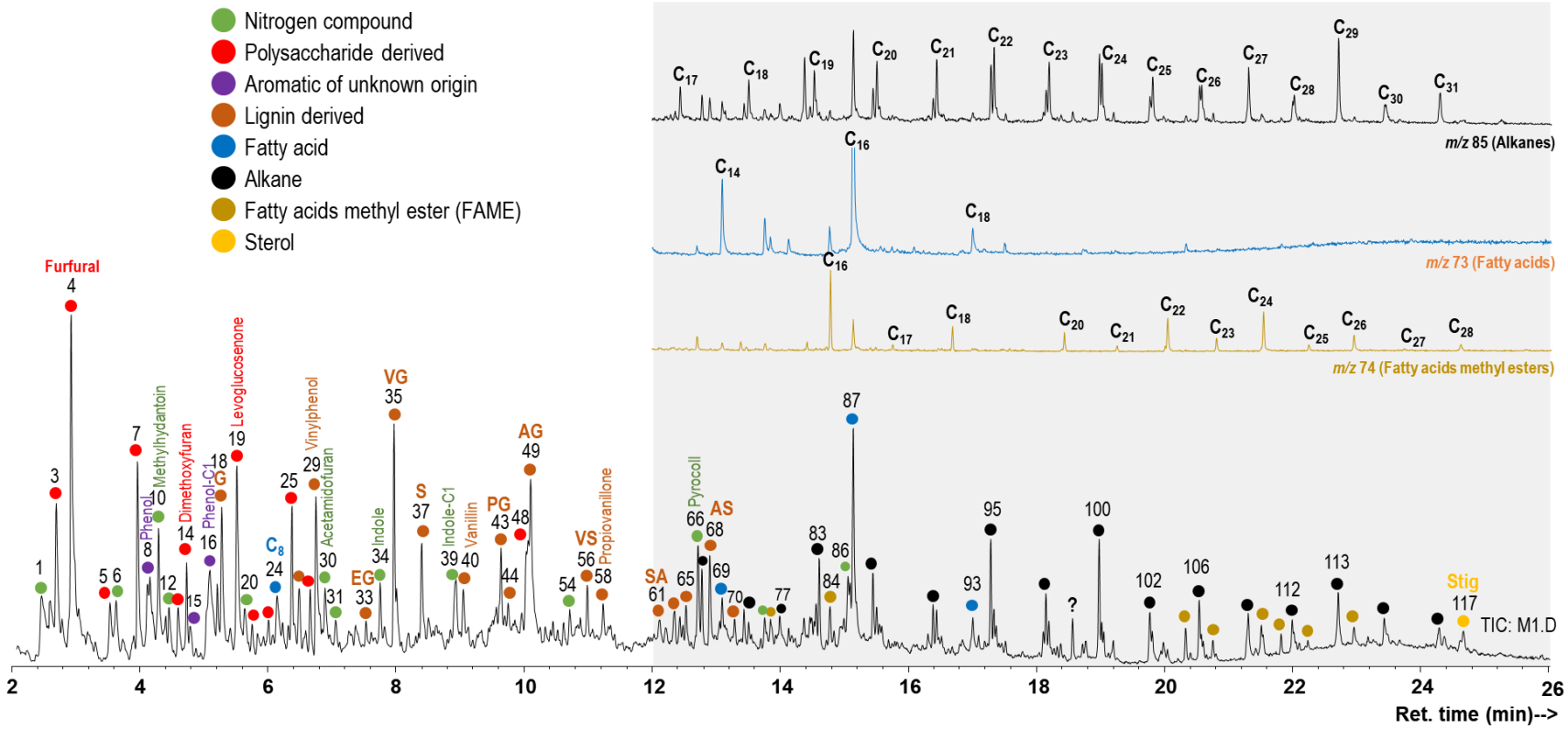
4 climatic treatments

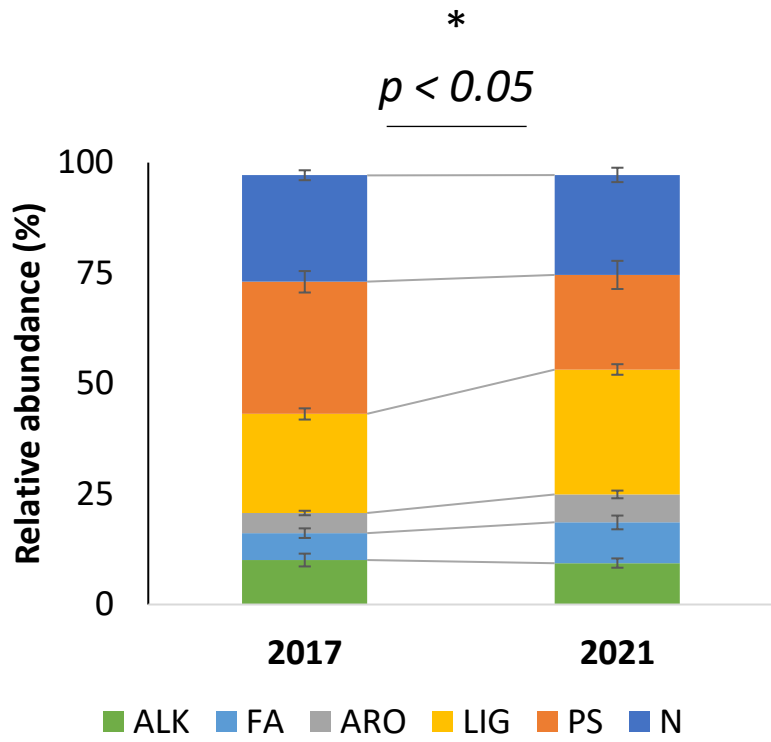
- **control (C)**
- **warming (W)**, an increase of 2 ºC induced according IPCC.
- **drought (D)**, excluding up for 30% of total precipitation
- **warming + drought (W+D)**

Analytical pyrolysis coupled with gas chromatography-mass spectrometry (Py-GC/MS)



Molecular composition of soil organic matter

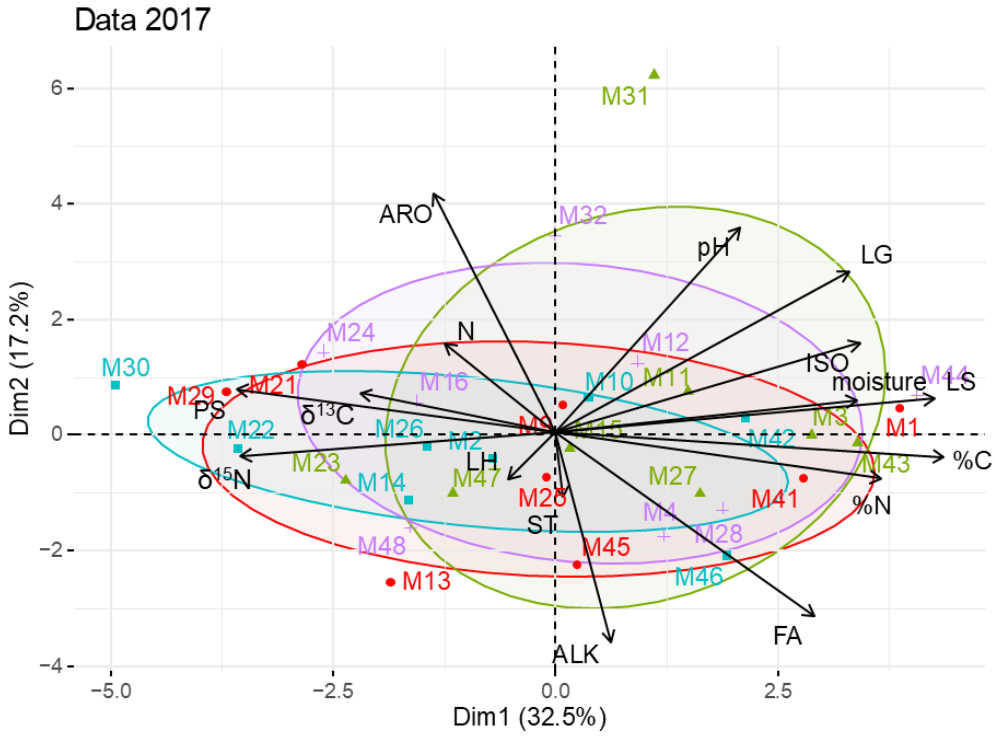


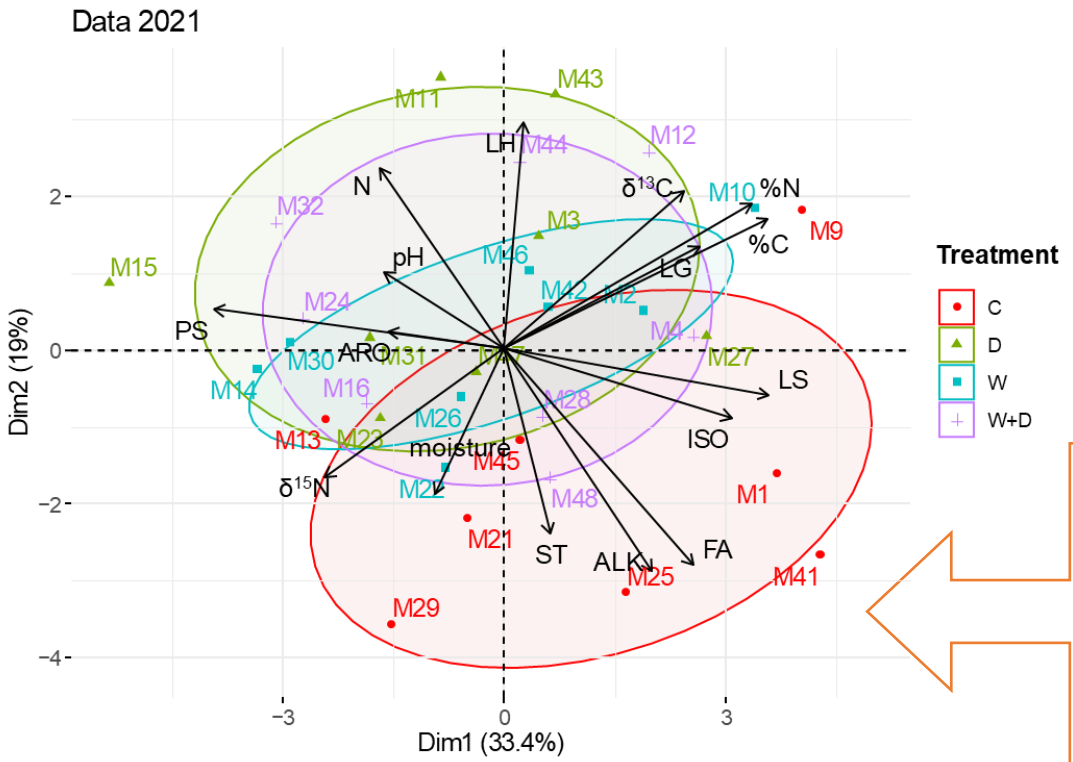


A total of 117 compounds were identified, where molecular composition mainly varied between ‘tree’ and ‘open’ habitats both in 2017 and 2021, for the main compound classes: **nitrogen compounds (N), aromatics (ARO), lignin methoxyphenols (LIG), fatty acids (FA), lipids (LIP) and polysaccharide-derived (PS).**

Multivariate analysis

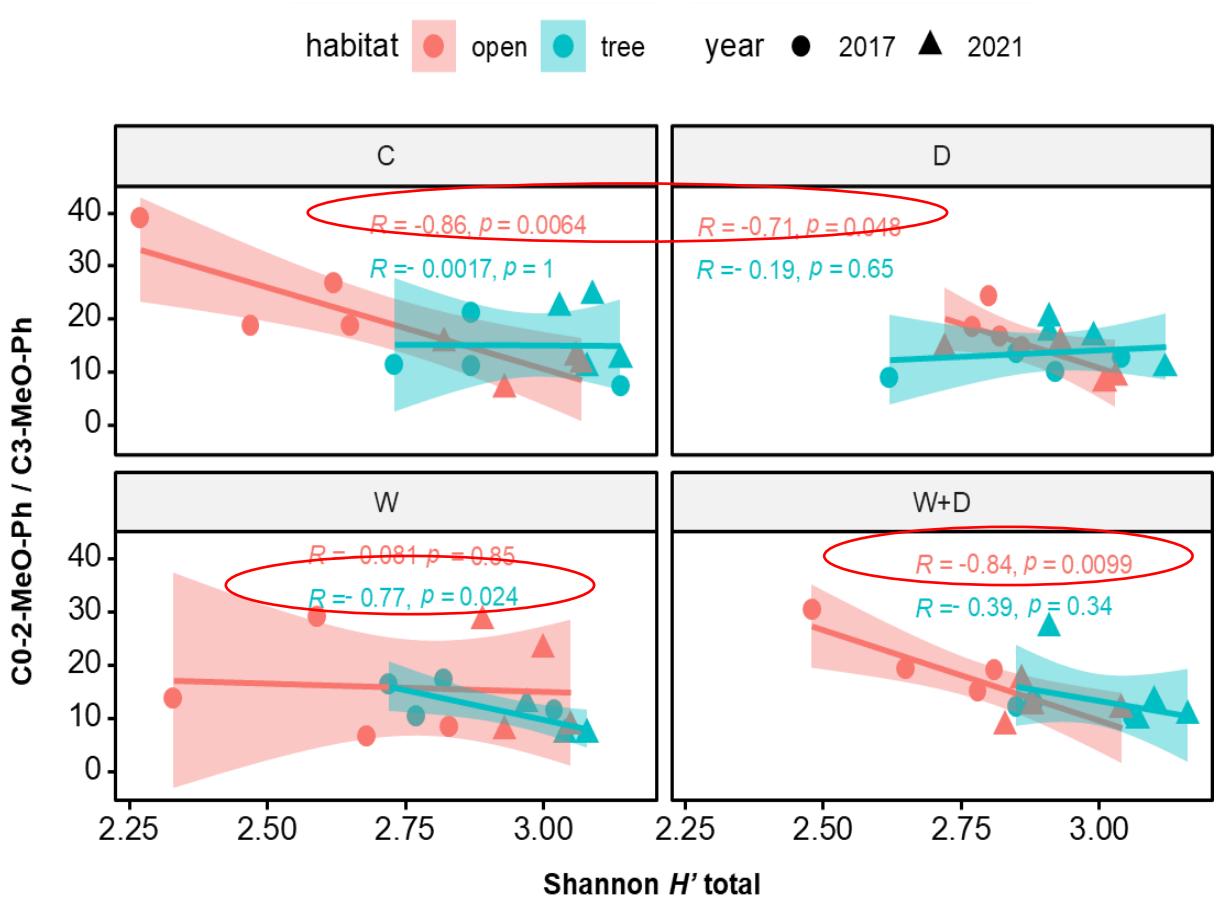
- **Differences were mainly driven by the habitat.**
- **Field-induced climatic treatments are more pronounced after 5 years.**
- Higher correlation of polysaccharides with the drought-induced treatments → **preferential microbial degradation.**
- Increasing proportion of ARO and short and mid-chain FA, pointing to **non-favourable SOM decomposition conditions.**





Aliphatic compounds (FA, ALK) were found most responsive to climatic treatments after 5 years, showing **negative correlation with D and W plots.**

Diversity of methoxyphenols



- Significant **negative correlation in open pasture** between the oxidation of lignin methoxyphenols and the diversity, specially at the beginning of the experiment.
- Exception for warming treatment, with the same trend but in tree habitat. → **higher degree of alteration of lignin macromolecules.**
- More linear trend in 2021 → **progressive loss with decomposition of the biogenic lignin structure.**

Concluding remarks

1. Differences in the SOM chemistry mainly driven by the effect of habitat, showing a **higher degree of SOM degradation in open pasture.**
2. **Five years of whole-soil experimental warming** altered the quality and quantity of SOM. Warming led to more microbial-transformed organic matter and loss of plant-derived SOM.
3. This points out to a decrease of total soil carbon storage potential in a warmer climate.
4. **Py-GC/MS** technique is an important tool for characterizing and assessing SOM structural aspects, hence the alteration of soil organic C sequestration mechanisms.
5. **Further investigation** of the microbial responses to climatic treatments, especially to warming is needed to extend the knowledge of the molecular responses found by Py-GC/MS.

Thank you for your attention!

More info about our project INTERCARBON and our contact info:

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Check out our lab's updates and latest publications in ResearchGate

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Acknowledgement: EU-EJC 2nd Call Projects MIXROOT-C and MAXROOT-C. L.M. San Emeterio thanks Ministerio de Ciencia Innovación y Universidades (MICIU) FPI research grant (BES-2017-07968) for funding. A.M. Carmona, M.D. Hidalgo and P. Campos are acknowledged for technical assistance.