GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN IN PUBLICA COMMODA SEIT 1737

TRUESOIL

EJP SOIL European Joint Programme

GEFÖRDERT VOM Bundesministerium für Bildung und Forschung

TRUESOIL PROJECT

Understanding trade-offs and dynamic interactions between SOC stocks and GHG emissions for climate-smart agrisoil management

Authors: Apostolakis A.[1], Englert P.[1], Münter C.[1], Dörsch P.[2], Jumadi O.[3], Khalil I.[4,8], Klumpp K.[5], Morales S.[6], Chukwuebuka C.O.[7], Osborne B.[8], Perez-Quezada J.[9], Philatie M.[10], Posse G.[11], Frasier I.[11], Restovich S.[11], Serrano-Ortiz P.[12], Kjær S.T.[2], Turunen P.[10], van Wesemael B.[13], Verheijen F.[14], **Meijide A.[1]**

Visit our **website** & **follow** us on **Twitter**

Sharing is encouraged | Website | Twitter

1. Introduction

Agricultural soils are in general depleted in soil organic carbon (SOC) and, therefore, exhibit a high potential for carbon (C) sequestraton. Various **agroecological practices** (APs) aim to maintain or **increase SOC** either by increasing C inputs into the soil, or by decreasing soil C losses. However, APs might potentially **increase greenhouse gas** emissions (GHGs), which could limit their **climate change mitigation** potential.

2. Main project objectives

The **EJP-SOIL** project **TRUESOIL** (2022-2025) investigates the "true" climate change mitigation potential of climate-smart APs under broad climatic and environmental gradients. It will investigate:

- how **GHG emissions** respond to changes in **SOC under climate-smart APs** across a wide range of climates and soils.
  - ❖ **particultate** and **mineral-associated** OC by wet sieving*
  - ❖ **GHG emissions** with **chambers*** and **Eddy Covariance** towers⁺
- mechanisms of **SOC persistence** and **N_2O emissions** under climate-smart APs and **reduced rainfall**.
  - ❖ **rain-out shelters** intercepting 50% of the occuring precipitation⁺
- the role of **microbial community** composition as **shaped by APs** in SOC persistence and GHGs emissions.
  - ❖ **carbon use efficiency** (CUE) with DNA-18O incorporation⁺
  - ❖ **lab incubations** to explore N-cycling potentials and links to CUE⁺
- **SOC & GHG trade-offs** under existing & alternative conditions
  - ❖ **process-based modeling** with DNDC model calibrated with TRUESOIL data & run for alternative climate & management scenarios⁺

Abbreviation: * in every field-site/sample; ⁺ in selected field-sites/samples

3. Consortium and field sites

With partners from **13 countries** over 5 continents, TRUESOIL is a world-wide consortium totaling **20 experimental sites** (Fig. 1). Spanning from boreal to tropical climates, TRUESOIL covers **broad environmental gradients** (Fig. 2).

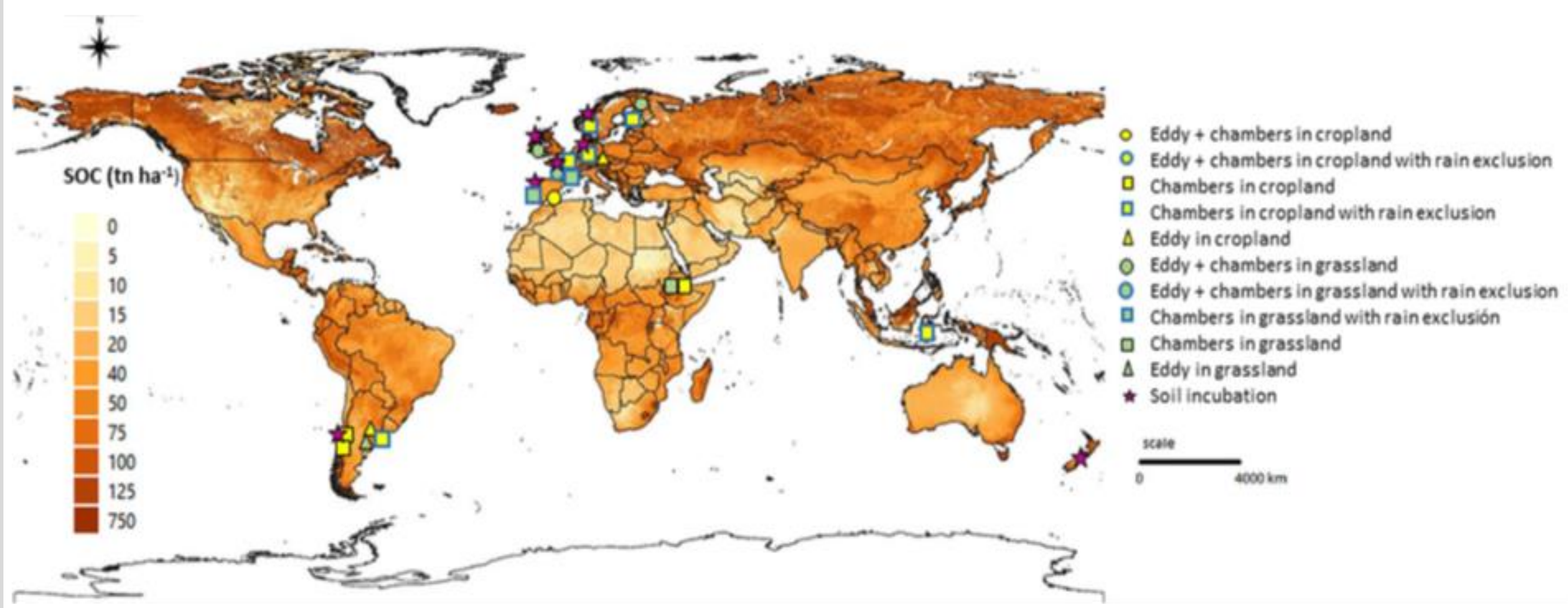

Fig. 1: Global SOC map after FAO (2017) and project sites.

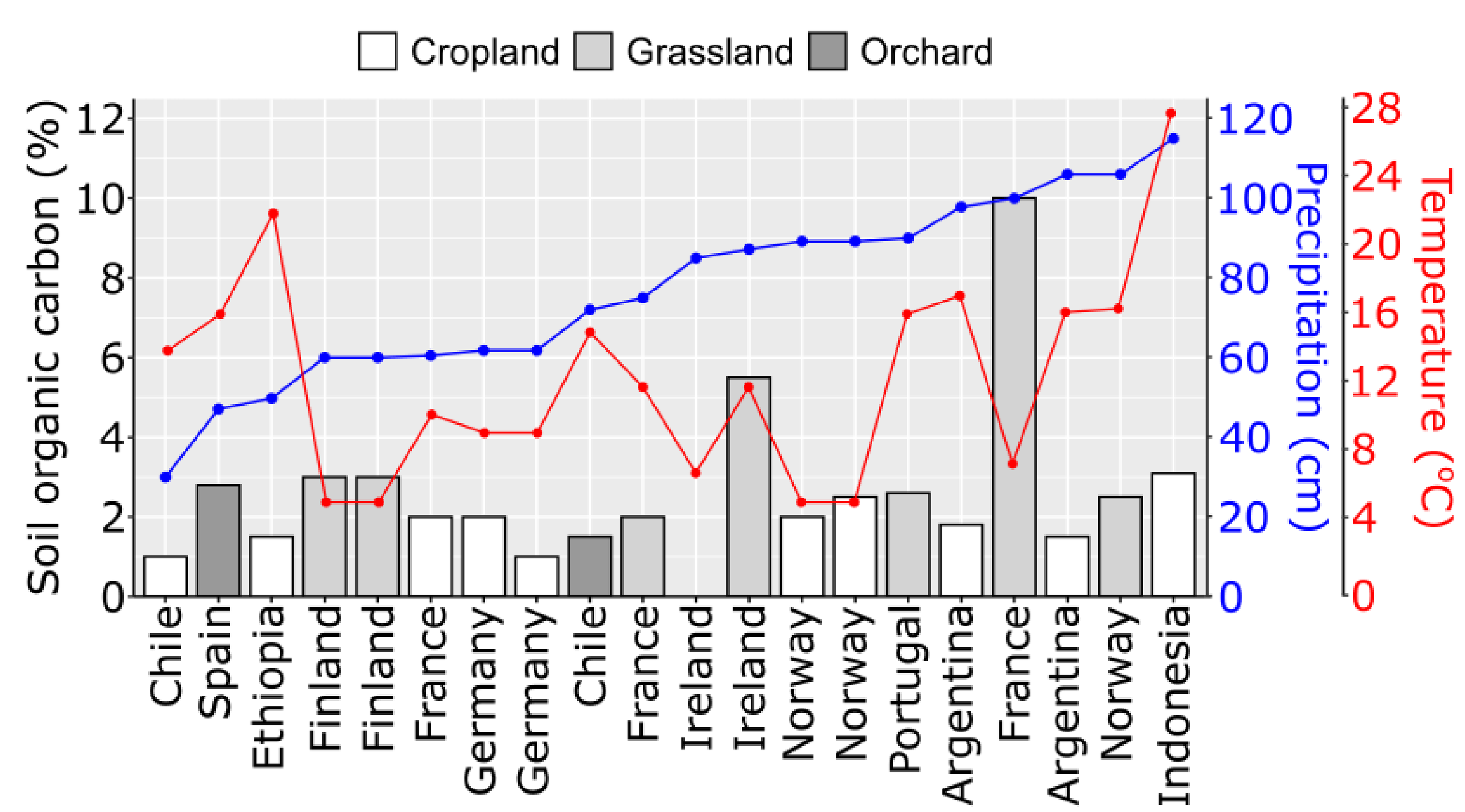

Fig. 2: SOC content, mean annual temperature and precipitation for project sites.

4. Impressions

Fig. 3: GHG measurements in the TRUESOIL project.

5. Main hypotheses

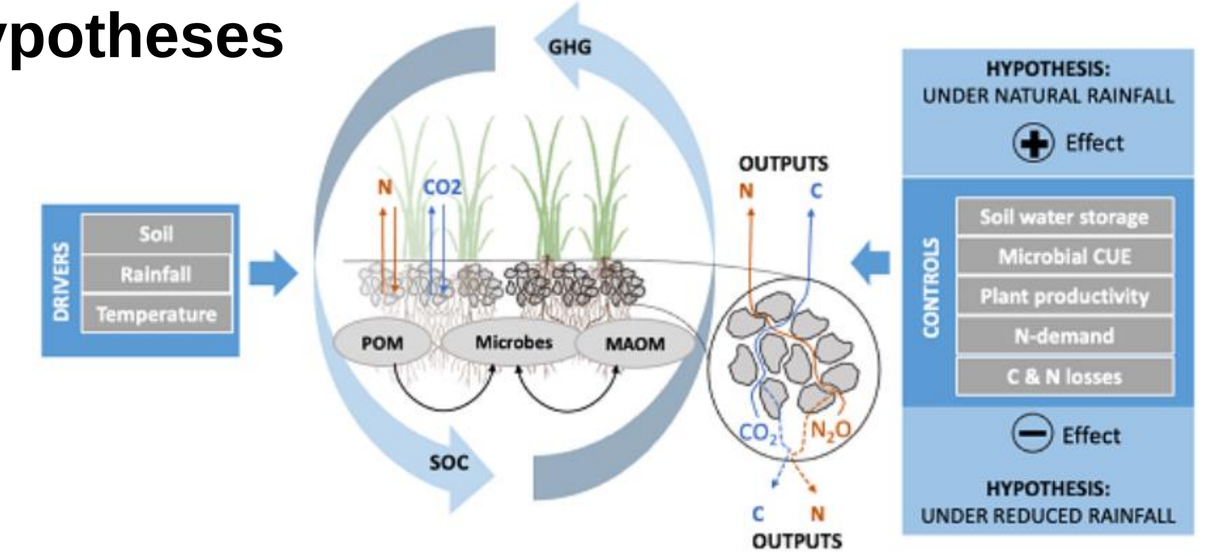

Fig. 4: Graphical abstract of TRUESOIL hypotheses.

1. APs aiming at increasing SOC lead to increased GHGs emissions, in particular N_2O.
2. APs that increase inputs of labile C in the soil lead to increased soil C sequestration due to high microbial C use efficiency and diversity.
3. Trade-offs between soil C sequestration and GHG emissions vary between APs and environmental conditions.
4. Reduced rainfall reduces soil water content & plant productivity limiting, thus, soil C sequestration and lowering GHG emissions. The amelioration effects of APs might sustain, at least partially, these functions under reduced rainfall.
5. Soils rich in OC are susceptible to losses of stored C, while non-CO_2 GHG emissions decrease.

[1]University of Göttingen, Göttingen, Germany; [2]Norwegian University of Life Sciences, Norway; [3]Universitas Negeri Makassar, Indonesia; [4]Prudence College Dublin, Ireland; [5]National Research Institute for Agriculture and Environment, France; [6]University of Otago, New Zealand; [7]Jimma University Ethiopia, Ethiopia; [8]University College Dublin, Ireland; [9]University of Chile, Chile; [10]University of Helsinki, Finland; [11]Instituto Nacional de Tecnología Agropecuaria, Argentina; [12]Universidad de Granada, Spain; [13]Université Catholique de Louvain, Belgien; [14]University of Aveiro, Portugal