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TRUESOIL PROJECT

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

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Abstract

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1. Introduction

Agricultural soils are in general depleted in soil organic carbon (SOC) and, therefore, exhibit a high potential for carbon (C) sequestration. 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** (GHG), which could limit their potential to **mitigate climate change**.

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.
  - **particulate** 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 GHG emissions.
  - **carbon use efficiency** (CUE) with DNA-^{18}O incorporation+
  - **lab incubations** to explore N-cycling potentials and links to CUE+
- **SOC & GHG trade-offs** under existing & alternative conditions
  - process-based model **DNDC**, calibrated with TRUESOIL data, will simulate C & N cycling under 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).

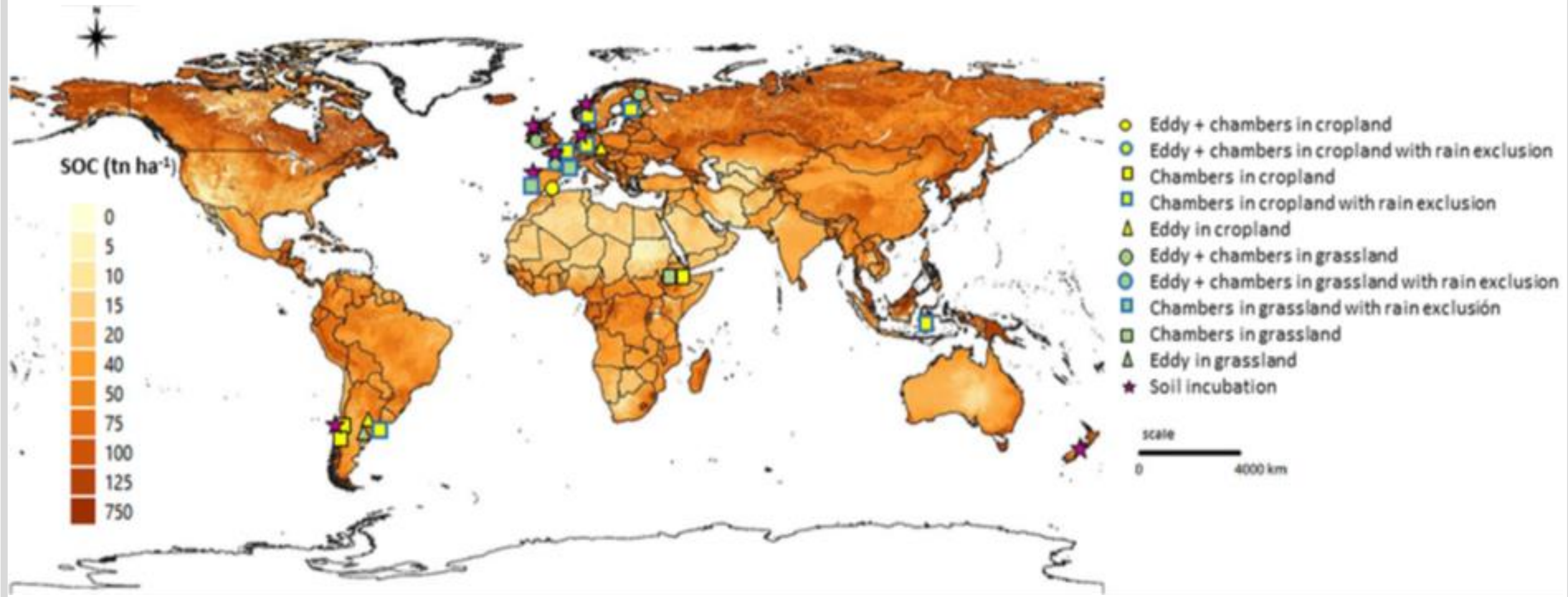

Fig. 1: Global SOC map after FAO (2017) and project sites.

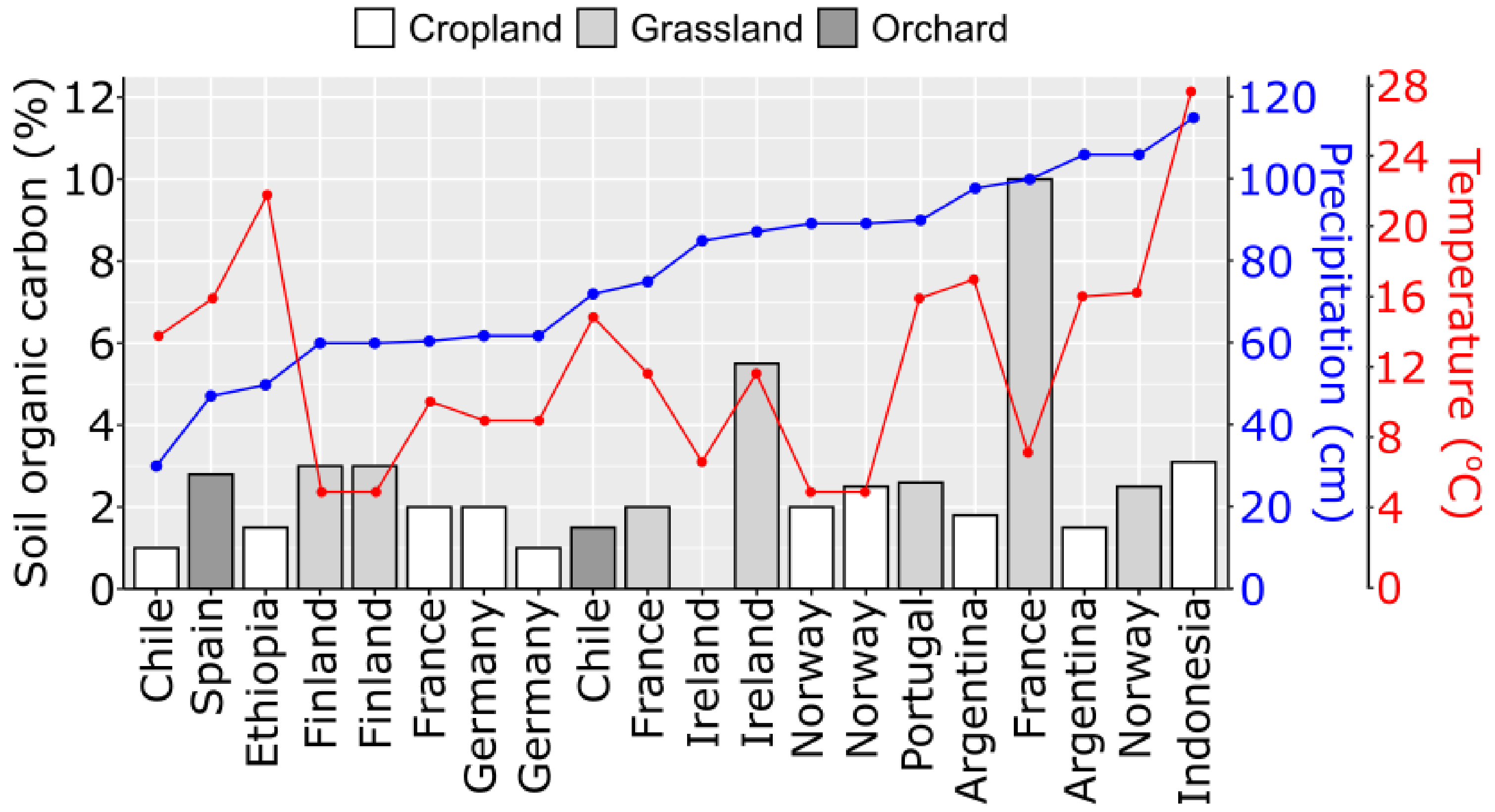

Fig. 2: SOC content, mean annual temperature and annual precipitation for project sites.

4. A glance at TRUESOIL fieldwork

Manual chambers for gas sampling

Portable analyser under rainout shelter

Robot, mounted with gas chambers

Fig. 3: GHG measurements in the TRUESOIL project.

5. Main hypotheses

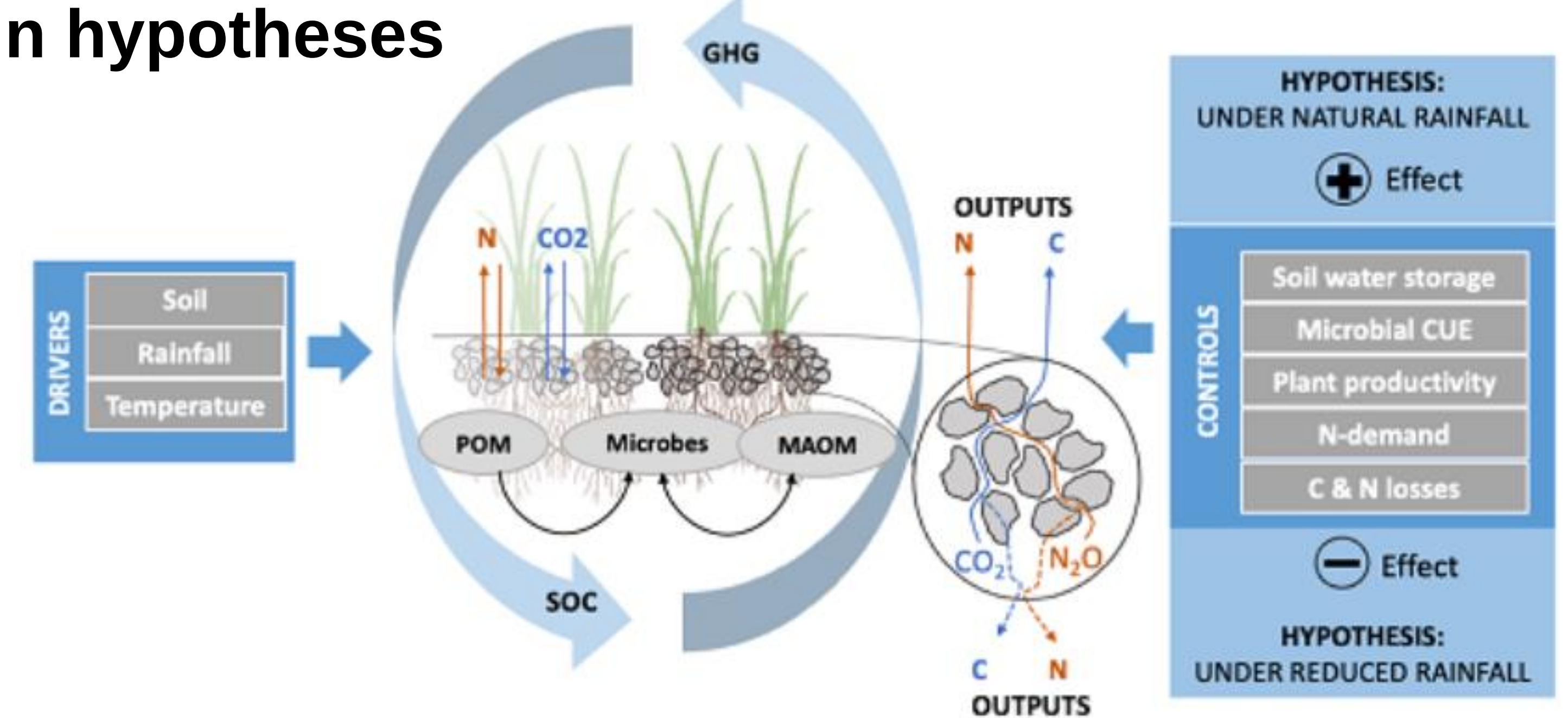

Fig. 4: Graphical abstract of TRUESOIL hypotheses.

1. APs aiming at increasing SOC lead to increased GHG 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. Rainfall exclusion reduces plant productivity, limits soil C sequestration and reduces GHG emissions. APs might sustain these functions under reduced rainfall at least partially.
5. Process-based models can predict trade-off relations between GHGs and C sequestration in response to climate change.

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