The legacy effect of long-term management on greenhouse-gas fluxes in European croplands

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Background

- As an effort to mitigate climate change, there is an increasing interest to implement agricultural practices aiming at increasing C storage in soil. However, the agricultural sector is also the largest contributor to anthropogenic non-CO_2 greenhouse gases[1]. Even small impacts in N_2O and CH_4 fluxes can largely offset mitigation efforts in agriculture[2,3].
- Therefore, management practices that produce a "win-win" scenario with synergetic mitigation effects should be promoted. Nevertheless, only few studies comprehensively address trade-offs between these two areas[4]. This is the gap that the ∑OMMIT project[4] aims to bridge.

Methodology: Incubations

(1) Sampling soil cores from selected long-term experiments

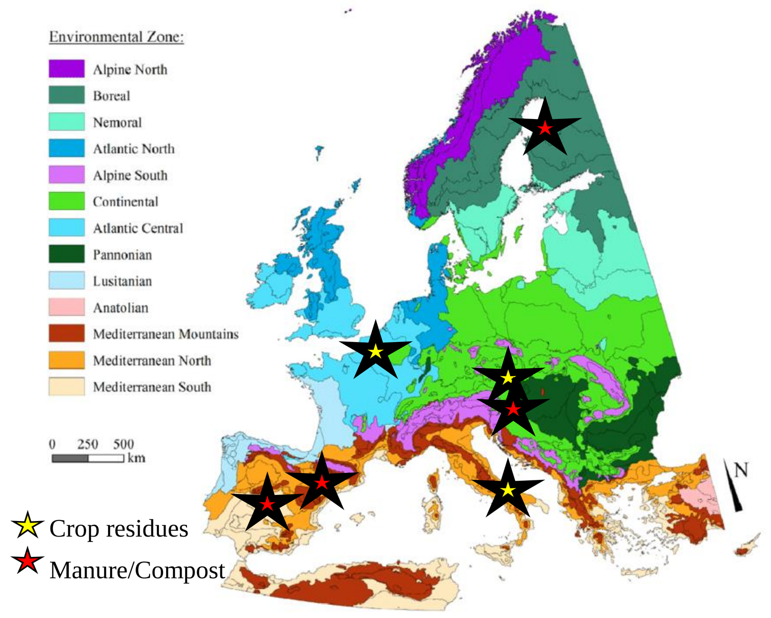


Figure 1. Location of long-term experiments on the environmental stratification of Europe[5].

(2) Gas analysis during drying and rewetting

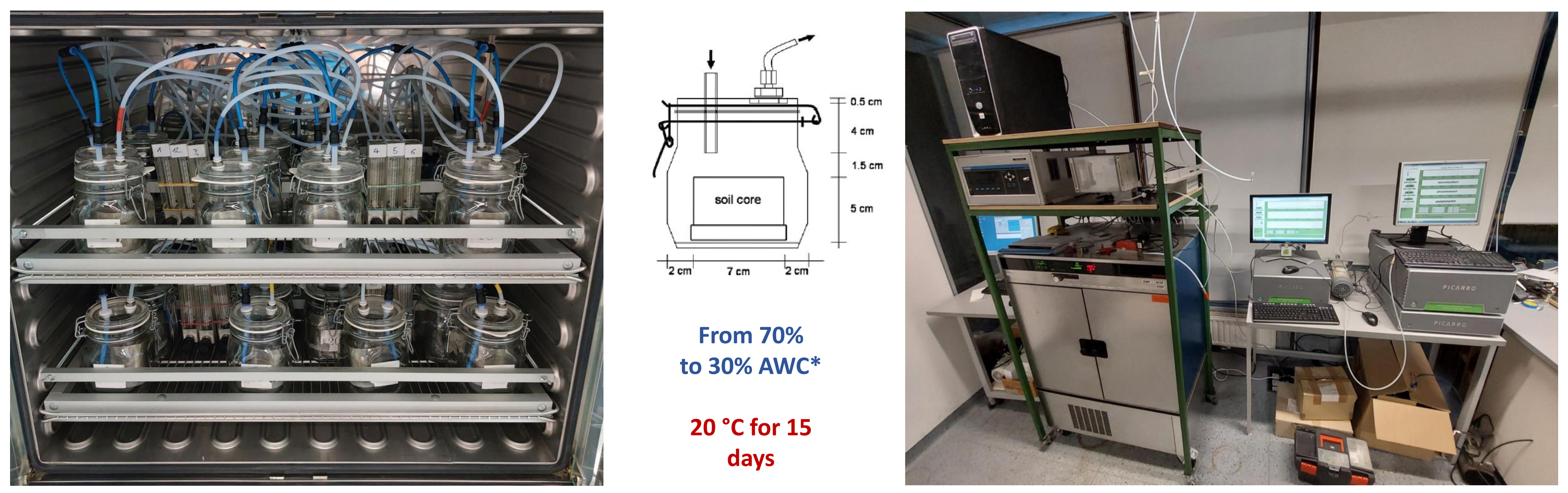


Figure 2. Incubator with automated dynamic-chamber system (left). Scheme of the incubation jars[6] (center). Incubation system (right) coupled to CO_2/CH_4 analyzer and isotopic N_2O cavity ring-down spectrometer. *AWC: Available Water Content

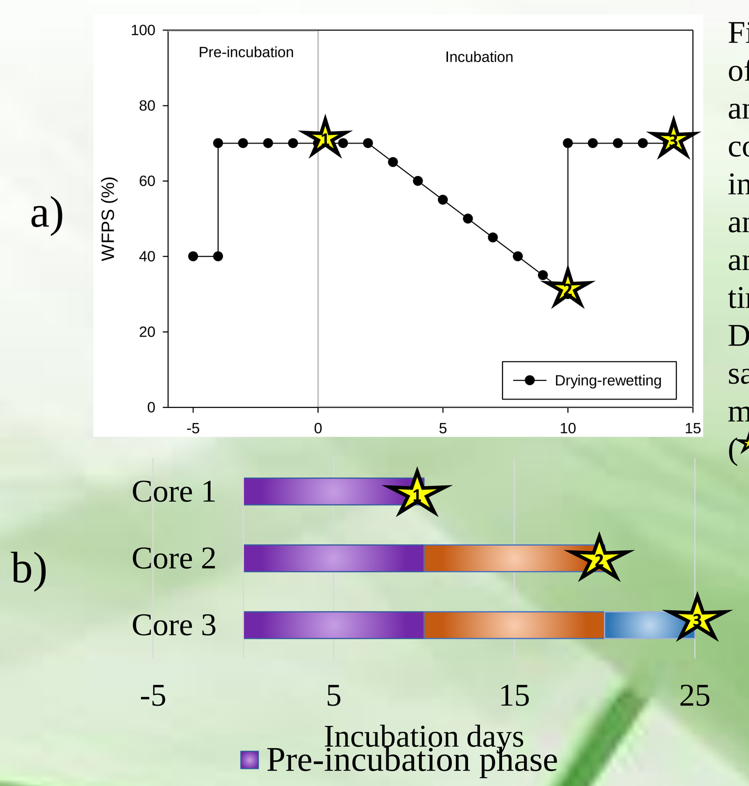


Figure 4. Scheme of (a) the handling and use of the cores along the incubation process and (b) the drying and rewetting timing. Destructive samplings are marked with a star (☆).

(3) Soil analyses

- Soil-organic-matter fractionation[7]
- Phospholipid fatty acids (PLFA)[8]
- Enzyme activities[9]
  - urease, and b-glucosidase
- Microbial C & N
  - $CHCl_3$-Fumigation-Extraction
- DTN/NPOC
- NO_3^- and NH_4^+
- Soil microbial genes (qPCR) involved in:
  - N-cycling (amoA, amoB, nirK, …)
  - CH_4 cycling (mcrA, pmoA, …)
- Metabarcoding

Figure 5. Destruction, homogenization and sample preparation for soil cores (above). Intact soil cores (right).

∑OMMIT Project

∑OMMIT: Sustainable Management of soil Organic Matter to Mitigate Trade-offs between C sequestration and nitrous oxide, methane and nitrate losses.

Hypothesis

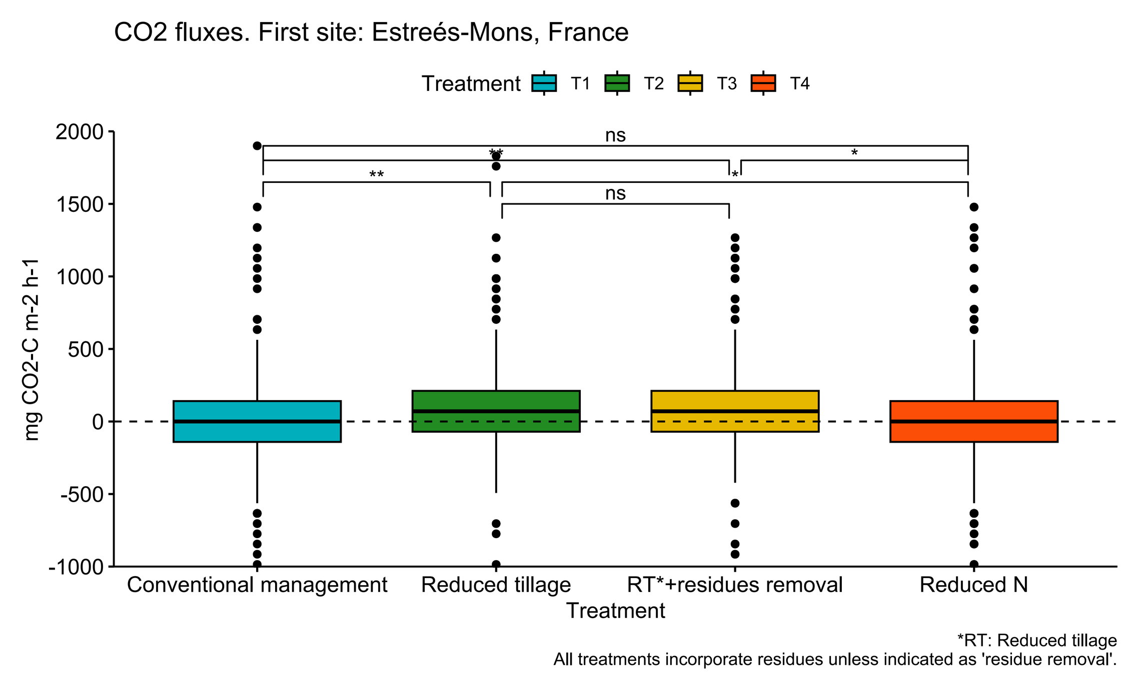
Specifically for the soil incubation task:

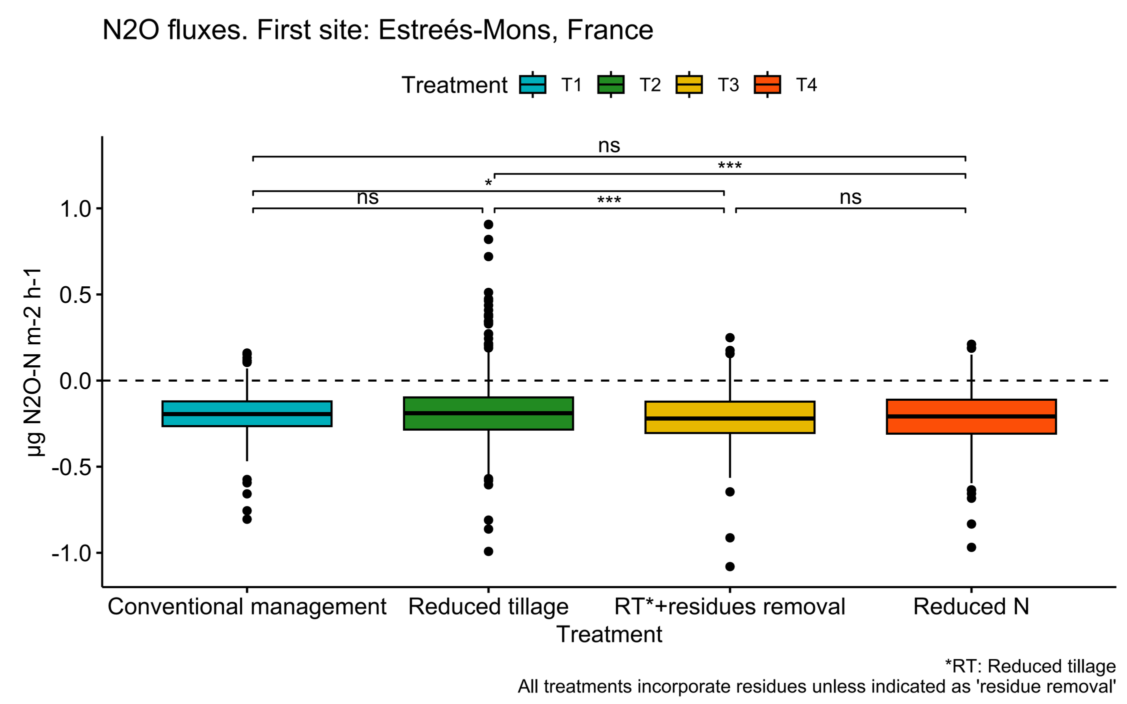
- Higher N_2O emissions when organic matter inputs were used in the long term such as:
  - liquid manure
  - solid manure
  - compost

  or

  - incorporation of crop residues (instead of removing them).
- Higher N_2O emissions from soil with pedoclimatic conditions that favor C storage: cooler climate and finer soil texture.

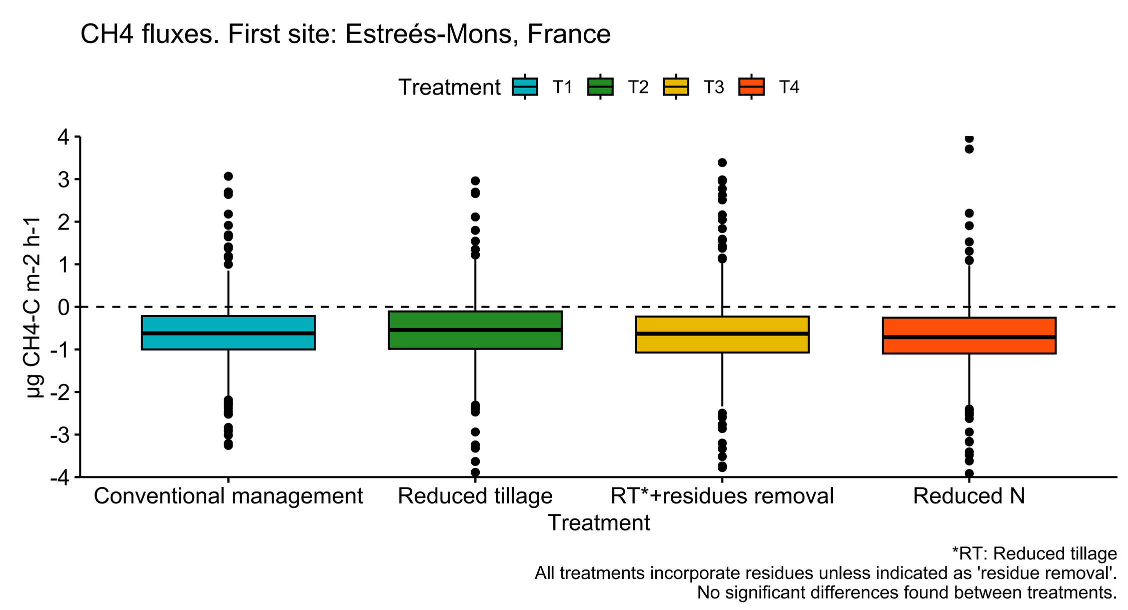
Preliminary Results





First outcomes:

- Emission (i.e., positive values) N_2O and CH_4 at specific times, but mostly negative values.
- Cores in the reduced tillage treatment, present an interesting trend for N_2O.
- Reduced tillage treatments presented higher mean values for CO_2.



Next steps:

- Data analysis in more depth for the site Estreés-Mons,.
- Incorporation of ancillary variables: moisture, SOC, microbial biomass, time series...
- Gas data extraction and analysis for other sites.
- Continue with soil samplings and incubations of other sites

References

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