THE COMBINE EFFECT OF AGRICULTURAL PRACTICES AND WATER INPUT ON N2O EMISSIONS FROM SOUTHWESTERN FRANCE CROPLAND: 5 YEARS OF MONITORING

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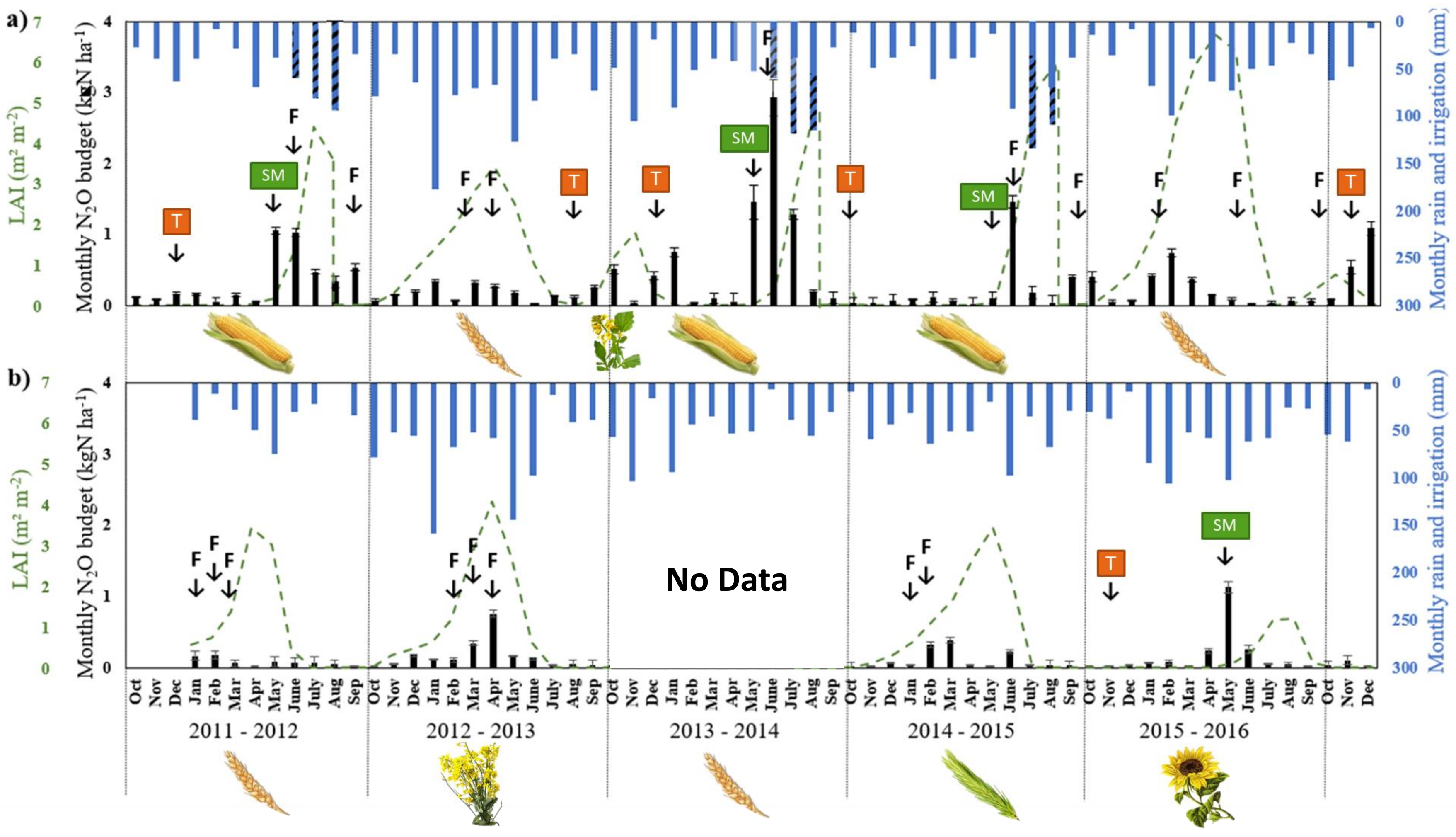
Context & Objectives

N_2O is the third gas responsible of the greenhouse effect, with a time life in the atmosphere of 116±9 years. Anthropogenic sources, and notably N fertilizer input, are the main contributor of the imbalance of N_2O in the atmosphere during the last decades. The interactions between the numerous common drivers of N_2O production and transport involve a non-linearity in N_2O emissions (Franco-Luesma et al., 2020). The effect of one management on N_2O emissions can be inhibited or enhanced by another one.

Objectives : **(1)** to document and enrich literature from the agricultural Southwestern France context **(2)** to explore the difference in annual and seasonal budgets by monitoring 2 typical summer crops (sunflower and irrigated maize) and 3 winter crops (wheat, barley and rapeseed) **(3)** to analyze the interacting effects of both agricultural practices overtime on N_2O emissions dynamic and **(4)** to develop an original methodology to estimate seasonal N_2O budget with few variables.

(1) Monthly cumulated N_2O Dynamic

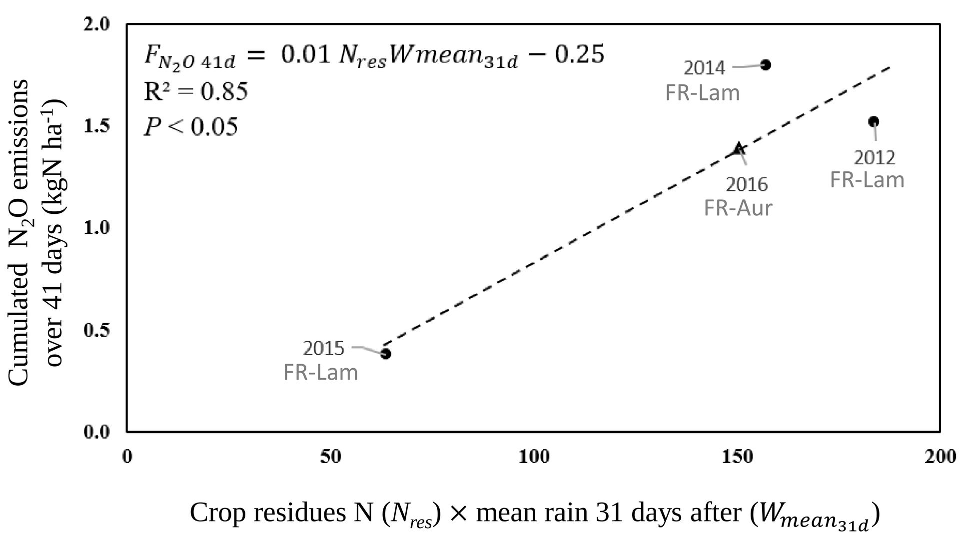
F : Fertilisation T Tillage > 20 cm SM Spring mineralisation



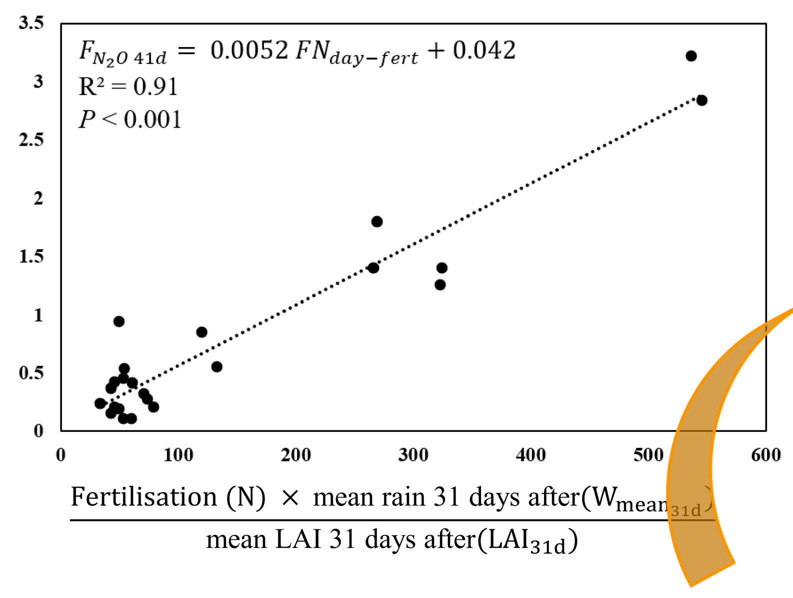
- Classic peaks of N_2O emissions after N fertilizer applications, after tillage > 20 cm which intensity depends on water supply amount (Rain + irrigation) for both and on Leaf Area Index (LAI) for N inputs.
- Highest emissions = during May and/or June before a summer crop on both sites. When the soil is bare, spring mineralisation of organic N residues triggers high N_2O emissions during summer cropping years.

(3) Combine effect of management and water input overtime

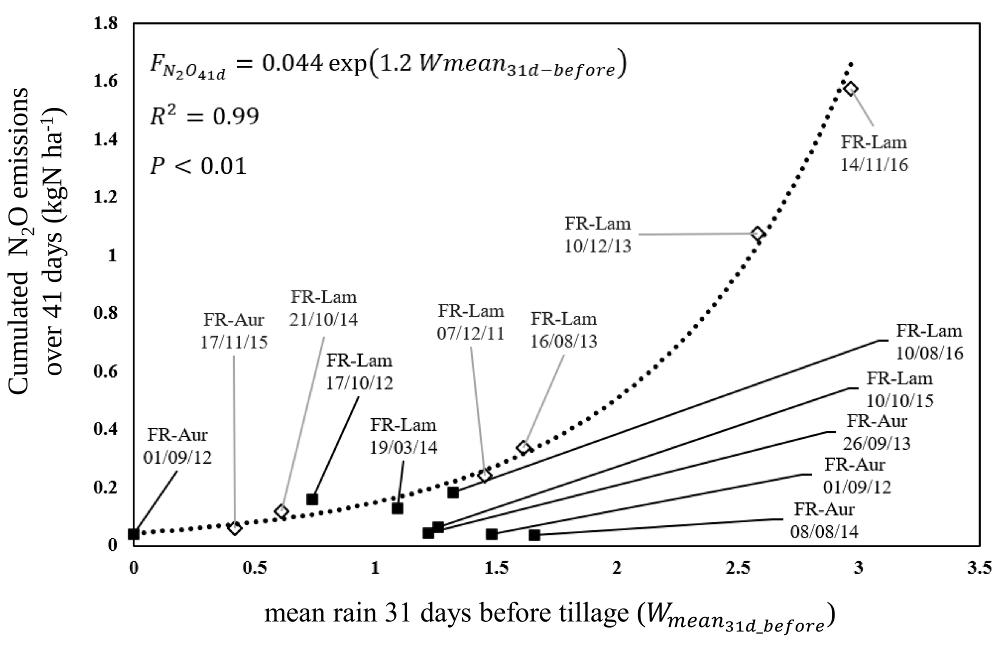
N residues + water effect



N fertilisation + GAI + water effect

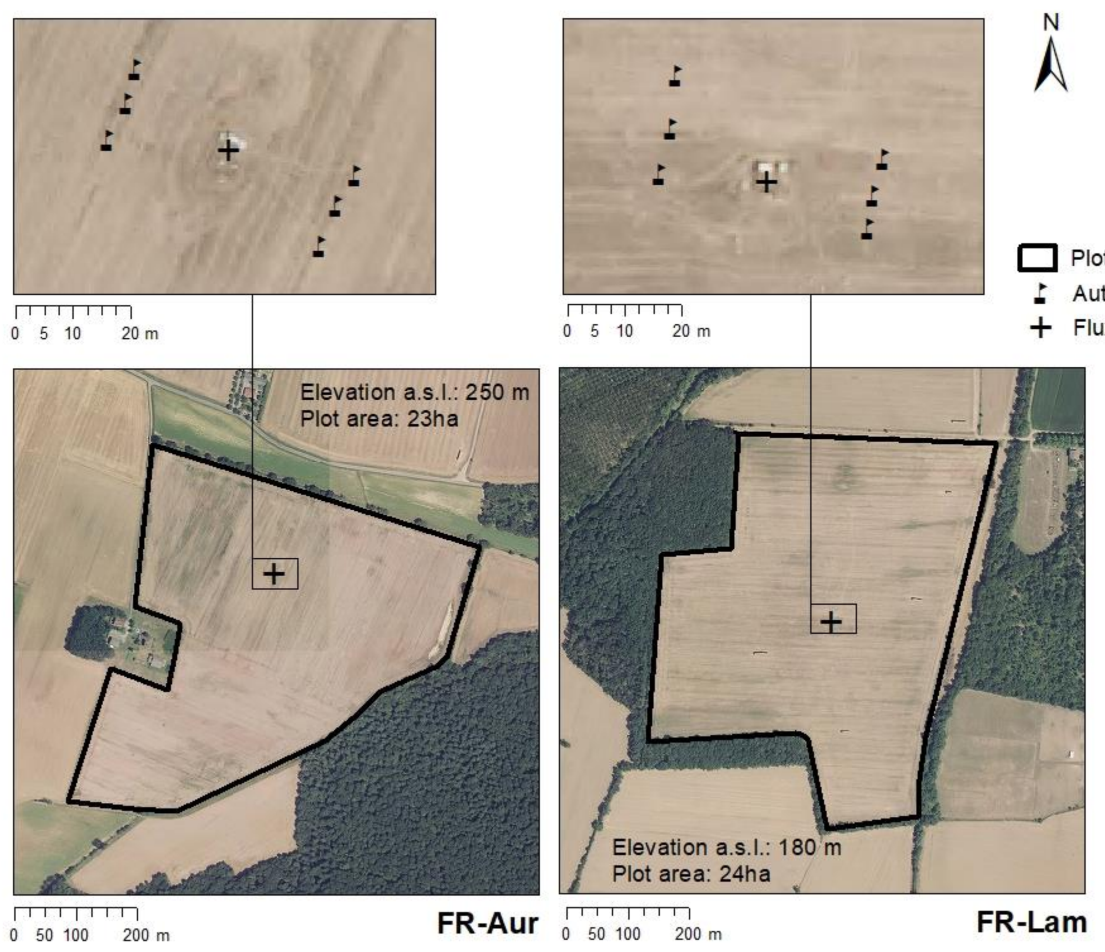


Tillage depth + water effect



- All drivers effect depended on water amount (rain+irrigation)
- Previous crop residues N amount were highly correlated with the spring emissions observed before a summer crop when soil is bare.
- N fertilisation effect was attenuated by stage of crop developement; higher GAI = better N uptake = lesser N_2O emissions
- Tillage >20 cm, after a long period of humid conditions, enhanced higher N_2O emission than a tillage < 20 cm.

Sites & methodology



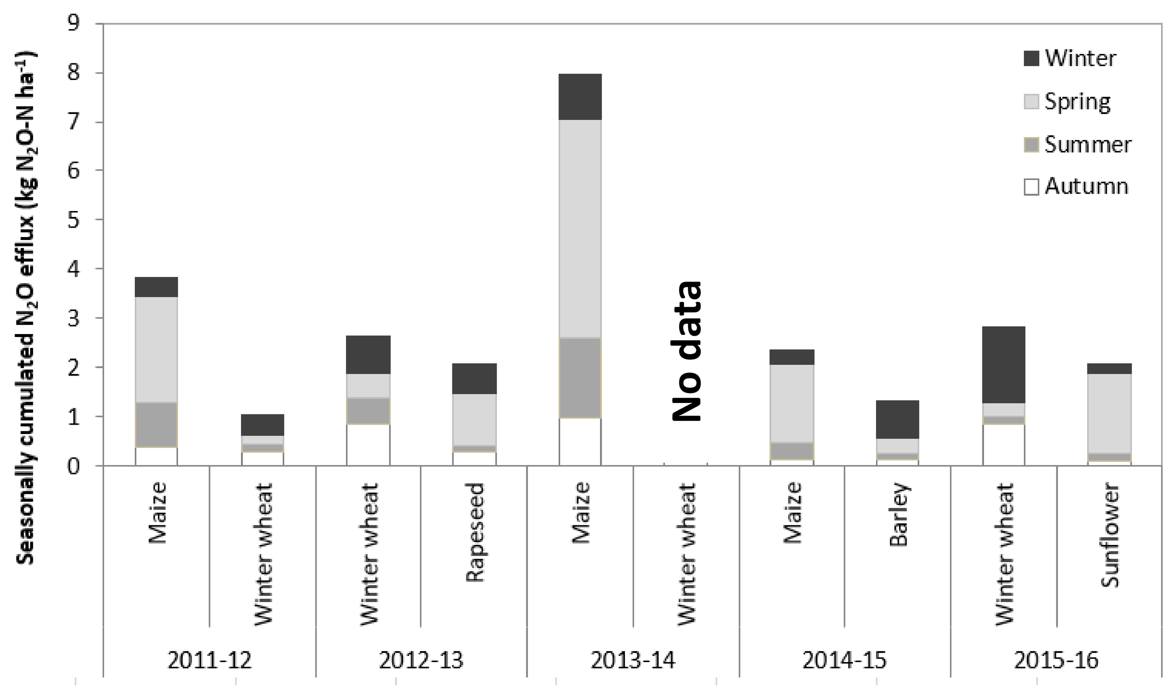
Soil text.	FR-Lam	FR-Aur
Clay	50	31
Silt	36	48
Sand	11	19
Org. Mat.	3	2

617 mm

13.7 °C

- A set of 6 automated chambers installed on each site ; Measurement cycle every 6 hours during 17.5 minutes (00, 06, 12, 18h).
- N_2O fluxes calculated, filterd and gap-filled according to Tallec et al. 2019 and Bigaignon et al. 2020 respectively.

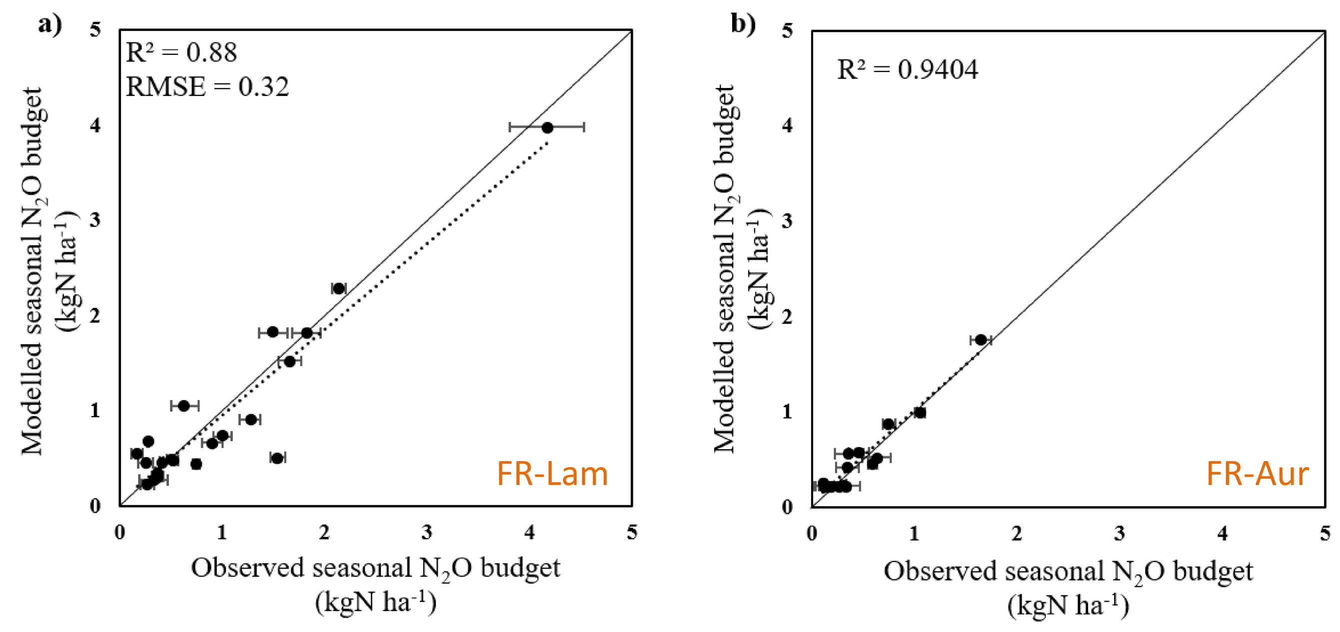
(2) Annual N_2O budgets and seasonal contributions



- **Summer crops** tended to present higher annual N_2O budgets ranging from 2.1 ± 0.1 to 8.0 ± 0.4 kgN ha^{-1} than **winter crops** ranging from 1.0 ± 0.5 to 2.8 ± 0.1 kgN ha^{-1}.

- **Summer crops :** spring season accounted for more than 50% of the annual N2O budget whatever the cropping year for maize crop at FR-Lam and reached 80 % of annual N_2O emissions for the sunflower crop at FR-Aur.
- **Winter crops :** the winter season contribution = on average > 40% of the annual N_2O emissions with high contribution of autumn season at FR-Lam due to manure sperading

(4) Seasonal N_2O budget simulation



- Based on the relationship relating explanative drivers and observed emissions, an empirical system of equations was developped (Bigaignon et al, in preparation) to simulate seasonal N_2O budget.

Perspectives

- To apply modelling experiment (NOE2-STICS) to simulate a control treatment, to analyse the N cycle (mineralisation, N-uptake, etc.), to precise the involved processes (denitrification, nitrification)… on our sites.
- To evaluate N-N_2O loss effects on agronomical performance, i.e. crop yield.
- To test the empirical methodology developed on other soil and climate conditions -> toward a better informed inventory from few variables

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