Restoring a worn-out pasture : What impact on N_2O exchanges ?

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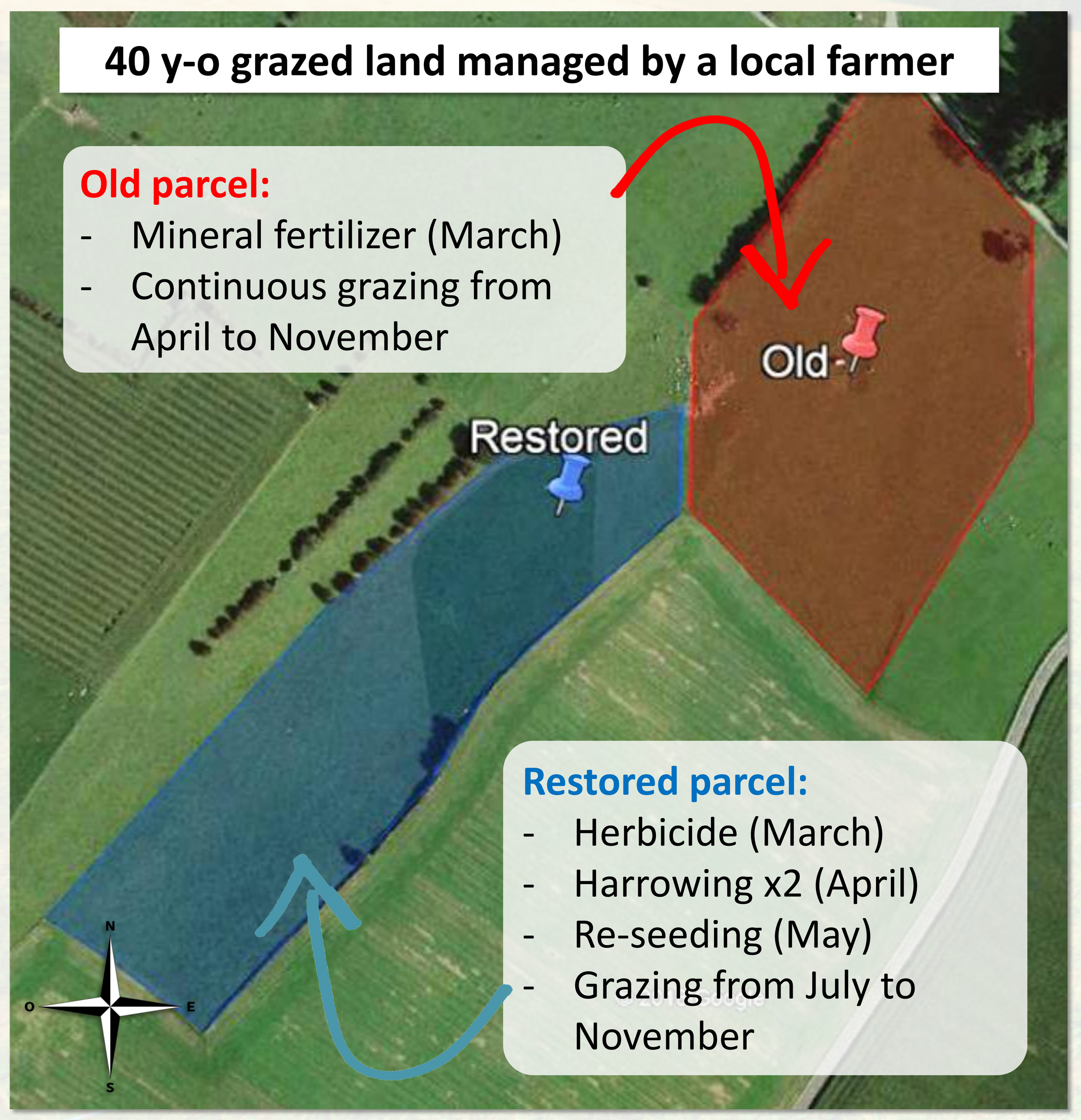
Context of the study

The restoration of permanent pastures is often required in order to recover a productive state and the palatability of the grass.

→ *What is the impact on N_2O flux for old pastures ?*

Paired-flux tower experiment



EC instruments :

- Wind velocity (CSAT-3)
- N_2O/CH_4 : Quantum cascade laser (Aerodyne Research Inc.) – CO_2 : Closed-path Li-7000 (LI-COR®)

Ancillary measurements :

- Meterorological variables
- Soil C and N content (twice a month)

RESULTS & ANALYSES

1. Flux dynamics from March 2018 to February 2019

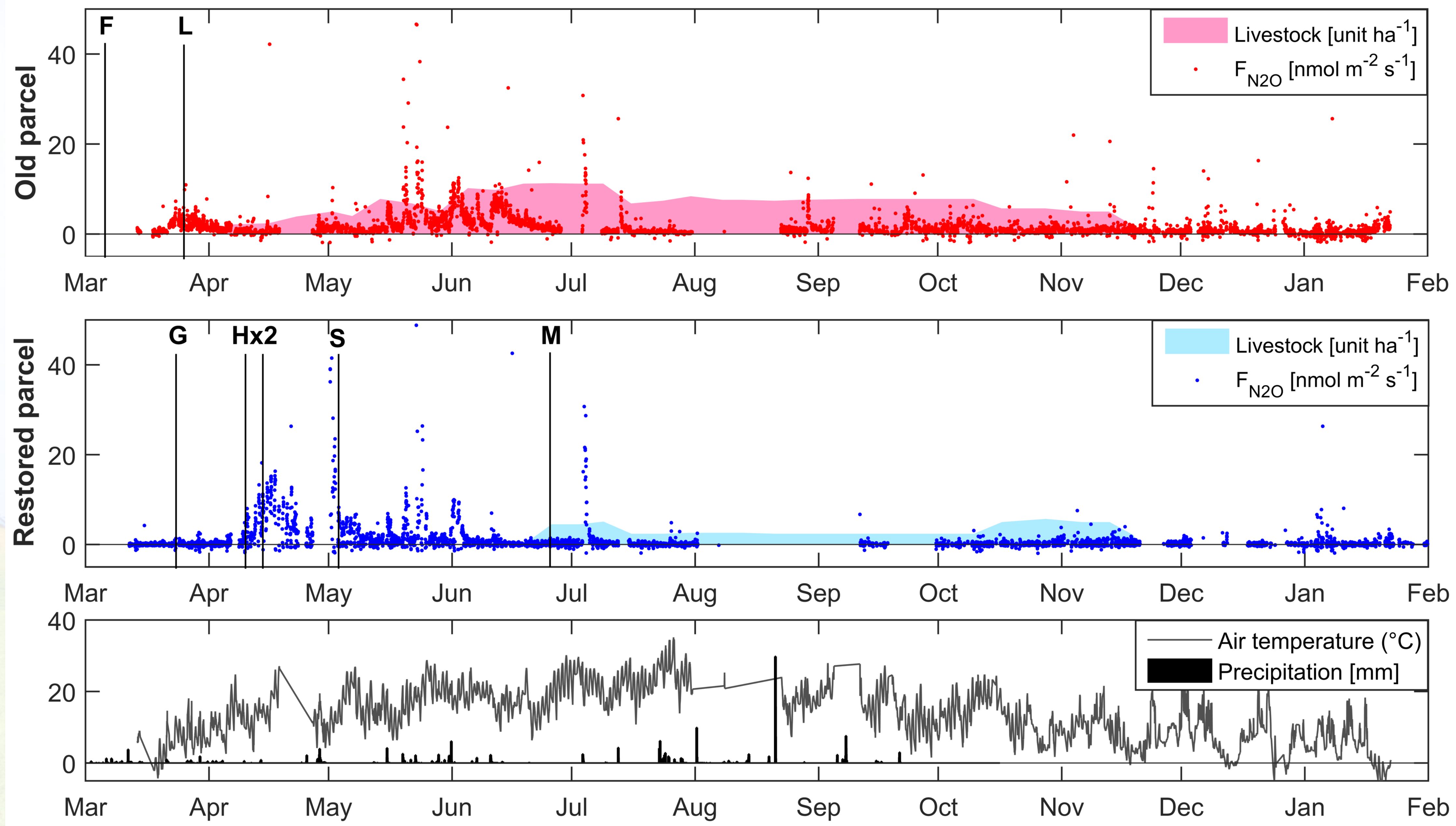


Fig. 1 – Top: N_2O flux (30 min) and livestock in the old parcel; Center: N_2O flux (30 min) and livestock in the restored parcel; Bottom: Air temperature (30 min) and daily precipitation. **F**: mineral fertilization, **L**: lime, **G**: glyphosate application, **H**: harrowing, **S**: seeding, **M**: mowing.

➢ **Similar range of N_2O emissions (0-50 nmol m^{-2} s^{-1}) in the old and in the restored parcel during the spring.**

⇨ The application of glyphosate in the restored parcel triggered the mineralization of organic N to ammonium (see **Fig. 3c**). Although the plot was not fertilized, such NH_4^+ production was sufficient to generate N_2O emission bursts.

⇨ Similar peak dynamics can be observed in May and June in both parcels. These episodes of high emission seem driven by precipitation.

➢ **In the restored parcel, harrowing triggered a major emission peak in April.**

⇨ The vegetation killed by the herbicide was being decomposed at the surface. Harrowing allowed the mixing of mineralized N to aggregates, making it available to soil microorganisms.

2. Identifying microbial mechanisms responsible for N_2O emissions

*Because it was difficult to assess a relationship between F_{N2O} and instant mineral N content (**Fig. 2**), the production rate of mineral N content (ammonium and nitrate) was investigated (**Fig. 3**) to better understand microbial mechanisms* ➔

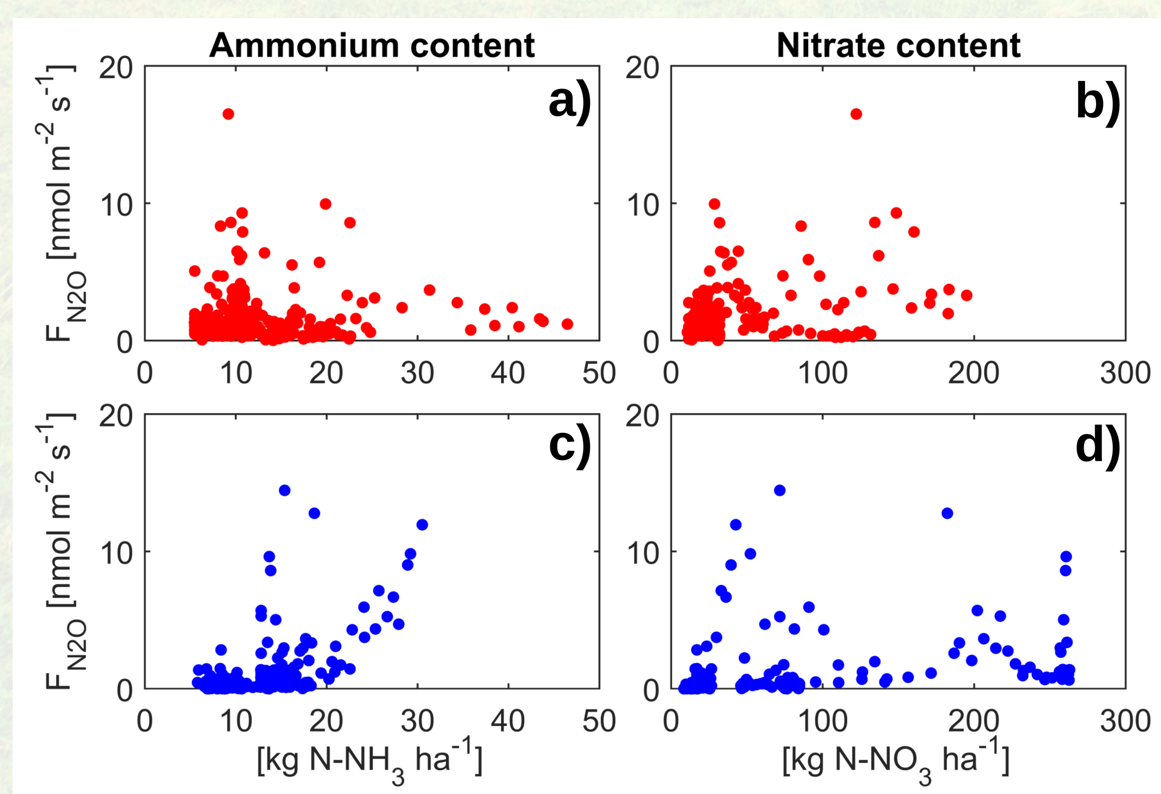


Fig. 2 – Daily averaged N_2O flux *vs.* soil ammonium and nitrate content in the old parcel (a and b) and in the restored parcel (c and d). N content values were interpolated linearly between sampling dates.

➢ **In the old parcel, the nitrification of NH_4^+ (May) was followed by denitrification (June).**

⇨ In May, nitrate was produced at a rate close to 10 kg ha^{-1} d^{-1}, while in June, it was being consumed as indicated by the negative rate (**Fig. 3b**).

➢ **In the restored parcel, organic N was first mineralized (before harrowing) to be then nitrified (after harrowing)**

⇨ Before harrowing, the evolution rate of ammonium was positive (**Fig. 3c**) while the nitrate soil content remained constant (**Fig. 3d**).

⇨ After harrowing, ammonium was being consumed (**Fig. 3c**) while nitrate content increased (**Fig. 3d**).

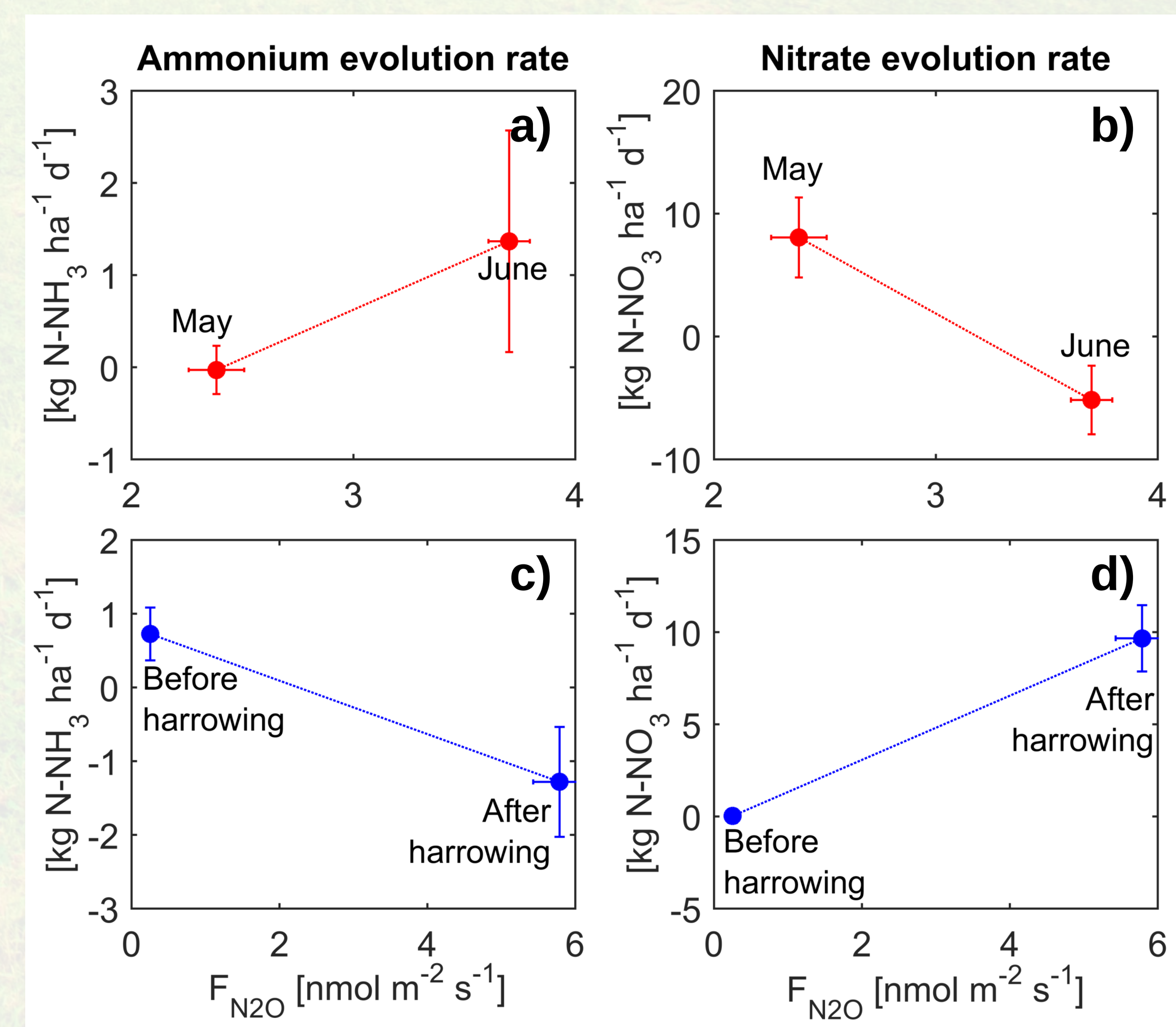


Fig. 3 – Evolution rate of soil ammonium and nitrate content during remarkable periods of the growing season in the old parcel (a and b) and in the restored parcel (c and d).