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

Lognoul Margaux, Gourlez de la Motte Louis, Debacq Alain, Naiken Alwin, Lonneux Mélissa, Jan Segers, Arriga Nicolas, Roland Marilyn, Yves Bekers, Bodson Bernard, Heinesch Bernard and Aubinet Marc.

CONTEXT

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

The restoration process consists of :

- Destruction of the former vegetation using herbicides
- Light tillage
- Reseeding

The short and long term impacts of such operations on the carbon cycle and on N_2O emissions are not well understood for old permanent pastures.

EXPERIMENTAL SET-UP

Ecosystem :

- 40 y-o grazed pasture managed by a local farmer
- One parcel (red) fertilized in the spring and grazed as usual
- The other one (blue) not fertilized and under restoration

EC instruments :

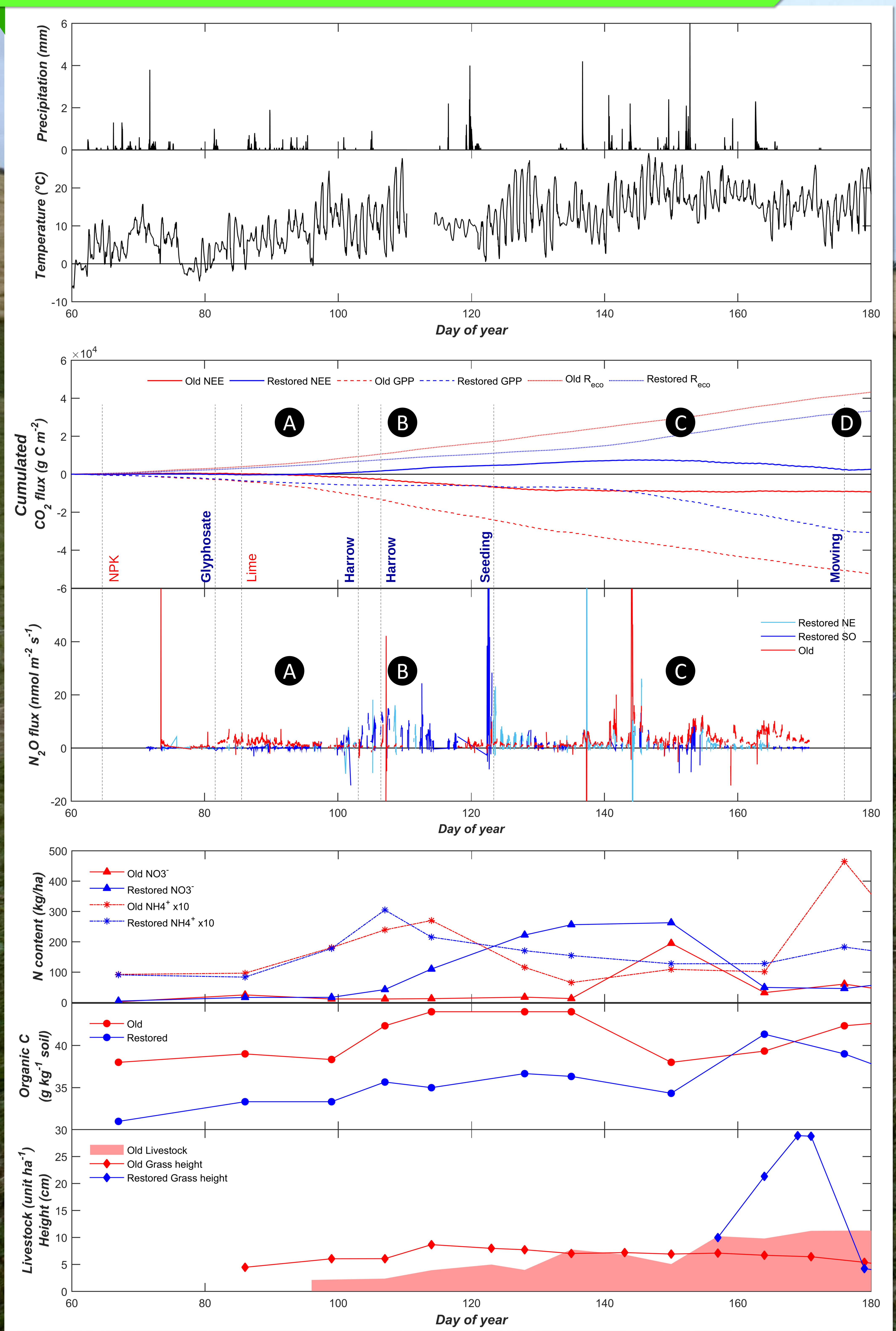
- Wind velocity (CSAT-3)
- N_2O/CH_4 : Quantum cascade laser (Aerodyne Research Inc.) – CO_2 : Closed-path Li-7000 (LI-COR®)

Additional data :

- 30-min monitoring of meteorological conditions
- Regular soil sampling and grass height measuring

Paired flux tower experiment (BE)

PRELIMINARY RESULTS – Dynamics from March to June 2018



Influence on CO_2 fluxes

A After glyphosate application

- Cumulated GPP_{Old} keeps increasing while $GPP_{Restored}$ reaches a plateau ;
- $Réco_{Old}$ increases faster than $Réco_{Restored}$
  ⇨ Could come from a decrease of autotrophic/heterotrophic respiration in the restored parcel.

B After harrowing

- The difference between $Réco_{Old}$ and $Réco_{Restored}$ increases :
  ⇨ However, no direct effect of harrowing on the respiration is observed.
- The restored parcel becomes a net C source as the ecosystem respiration exceeds the GPP.

C After seeding

- From day 140, $Réco_{Old}$ and $Réco_{Restored}$ evolve with a similar slope and $GPP_{Restored}$ resumes :
  ⇨ Growth of vegetation in the restored parcel.

D After mowing

- $GPP_{Restored}$ is slightly slowed down.

Influence on N_2O fluxes

A After glyphosate application

- Despite identical precipitations and similar nitrate and ammonium soil content, $F_{N2O,Old}$ are higher than $F_{N2O,Restored}$:
  ⇨ Limiting organic C content on the restored parcel combined to cattle urine on the old parcel ?

B After harrowing

- $F_{N2O,Restored}$ show an emission burst following harrowing, while nothing is detected from the old parcel :
  ⇨ Most likely a nitrification peak (↘ $NH4^+$ and ↗ $NO3^-$)
  ⇨ Role of harrowing on emission peak still to prove (burst also showing from NE winds)
  ⇨ Organic C content has increased : no more limiting ?

C After seeding

- Fluxes are comparable in the two parcels and follow the same dynamics :
  ⇨ Might be denitrification fluxes on both sides (heavy precipitations and decreasing nitrate content)

What's next…

- Monitoring until March 2019 (one year experiment) ;
- Investigation of the footprint from NE in the restored parcel ;
- Thorough analyses of GHG exchanges, including CH_4.

Contact: margaux.lognoul@ulg.ac.be

LIÈGE université
Universiteit Antwerpen
fnrs LA LIBERTÉ DE CHERCHER