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

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**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 N₂O 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)
- N₂O/CH₄: Quantum cascade laser (Acodyne Research Inc.)– CO₂: Closed-path Li-7000 (LI-COR®)

**Additional data:**
- 30-min monitoring of meteorological conditions
- Regular soil sampling and grass height measuring

**PRELIMINARY RESULTS – Dynamics from March to June 2018**

**Influence on CO₂ fluxes**

**A After glyphosate application**
- Cumulated \( \text{GPP}_{\text{old}} \) keeps increasing while \( \text{GPP}_{\text{restored}} \) reaches a plateau ;
- \( \text{Reco}_{\text{old}} \) increases faster than \( \text{Reco}_{\text{restored}} \)
   Could come from a decrease of autotrophic/heterotrophic respiration in the restored parcel.

**B After harrowing**
- The difference between \( \text{Reco}_{\text{old}} \) and \( \text{Reco}_{\text{restored}} \) 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, \( \text{Reco}_{\text{old}} \) and \( \text{Reco}_{\text{restored}} \) evolve with a similar slope and \( \text{GPP}_{\text{restored}} \) resumes :
   Growth of vegetation in the restored parcel.

**D After mowing**
- \( \text{GPP}_{\text{restored}} \) is slightly slowed down.

**Influence on N₂O fluxes**

**A After glyphosate application**
- Despite identical precipitations and similar nitrate and ammonium soil content, \( \text{F}_{\text{NO₂}} \) are higher than \( \text{F}_{\text{NO₃,restored}} \);
   Limiting organic C content on the restored parcel combined to cattle urine on the old parcel ?

**B After harrowing**
- \( \text{F}_{\text{NO₂,restored}} \) 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 CH₄.

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