Plant diversity affects GHG fluxes in an ecological engineering experiment in a disturbed Sphagnum peatland (La Guette, France)

Sébastien Gogo, Fatima Laggoun-Défarge, Fabien Leroy, Christophe Guimbaud, Léonard Bernard-Jannin

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A: Aim of the study

***Sphagnum* peatlands** are huge carbon (C) store, participating in the regulation of the global climate. Their **C sink function is under threat** because of global changes. In addition to their direct effects on ecosystems functioning , these perturbations induce **vegetation change toward increasing vascular plant abundance**. To reduce vegetation modification, hydrological restoration can be done to reduce water table fluctuations. Furthermore, ecological engineering actions can be undertaken to promote species efficient in storing C.

The aims of this study were to set up an **in situ experiment to test the effect of different vegetation treatment on the C fluxes** in a disturbed peatland.

B: Study site

La Guette peatland is in the Centre region, 100 km south of Paris.

It is an acidic fen invaded by ***Molinia caerulea***, ***Betula* spp** and ***Pinus sylvestris***. Typical peatland vegetation consists of ***Sphagnum*** *(e.g. S. rubellum, S. cuspidatum* and *S.), Eriophorum angustifolium, Rhyncospora alba, Gentiana pneumonanthe, Erica tetralix.*

SNO Tourbières
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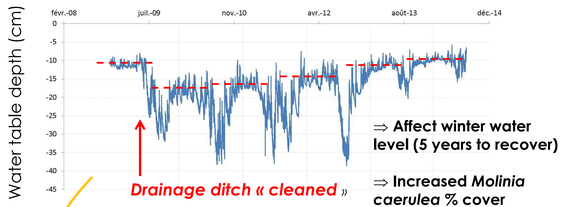
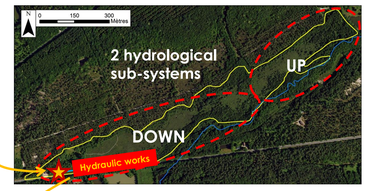
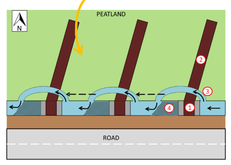
It is one of the four sites of the **French Peatland Observatory Service** (SNO Tourbières-CNRS)

C: Hydrological disturbance / restoration

Water table depth monitoring in the piezometer close to the outlet







Hydrological restoration

Legend:
1-weir
2-filled trench
3-deviation trench
4-standing water

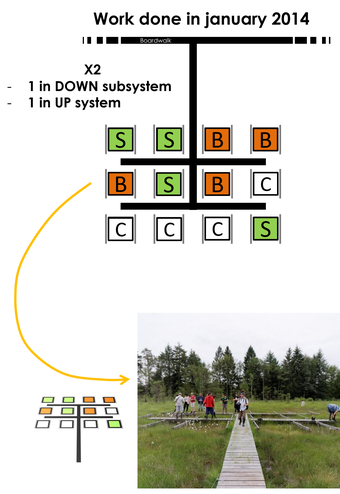
Work done in january 2014

D: Vegetation restoration experiment

Vegetation treatment that could promote biodiversity and C storing

⇒ 8 intact plots serve as **CONTROL** (4 DOWN, 4 UP)
⇒ 8 **BARE PEAT** plots after vegatation and peat stipping
⇒ 8 bare peat plots where 1 kg of fresh **SPHAGNUM** spp was added

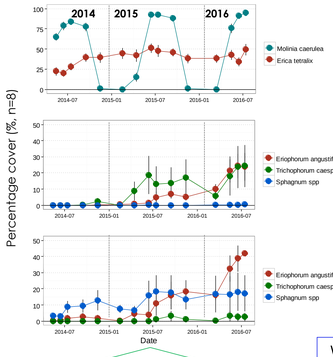
Work done in january 2014



Response variables
⇒ Ecosystem respiration
⇒ Net Ecosystem Exchange
⇒CH_4 flux
⇒Vegetation % cover
6 campaigns per year

E: Vegetation and C fluxes dynamics

Monitoring of vegetation % cover in C fluxes measurement plots



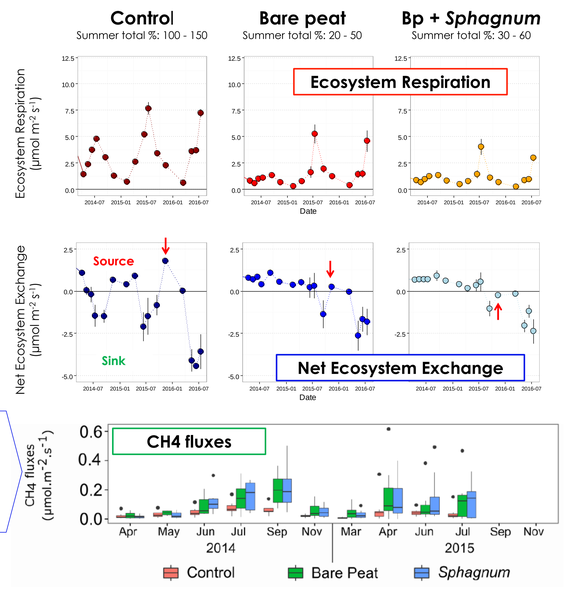
Control
Summer total %: 100 - 150

Bare peat
Summer total %: 20 - 50

Bare peat + *Sphagnum*
Summer total %: 30 - 60

Vegetation in **CONTROL** is stable with time. *Eriophorum angustifolium* and *Trichophorum caespitosum* colonised the **BARE PEAT**, whereas only the former was present with the moss in **SPHAGNUM** plots.

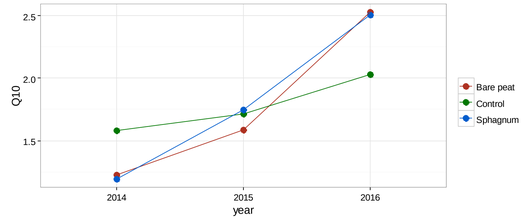
Monitoring of CO_2 and CH_4 fluxes



With time, ER and NEE increased in **BARE PEAT**, and **SPHAGNUM** plots. In winter (red arrows), **SPHAGNUM** plots tend to function as a C sink, unlike the other plots. CH_4 fluxes increased in **BARE PEAT**, and **SPHAGNUM** treatments.

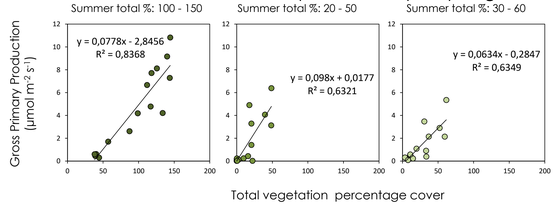
F: Sensitivity of ER to temperature and GPP to vegetation % cover

Variation of Q_{10} of ecosystem respiration with time



Q10 coefficient increases faster with time in BARE PEAT and SPHAGNUM plots than in the control plots.

Gross Primary Production versus vegetation % cover



GPP increases faster with vegetation % cover in CONTROL and BARE PEAT plots than in SPHAGNUM plots.

G: Discussion

The results suggested that:

- When no Sphagnum were added, the colonising vegetation may be more sensitive to temperature than control vegetation. Increased CO_2 emissions in early colonisation stages can be a negative point of the vegetation restoration .
- Although Sphagnum GPP is less sensitive than other plots to vegtation % cover , this plots were the most efficient to store C in winter.
- Also, the **BARE PEAT**, and **SPHAGNUM** treatments tended to increased CH4 emissions compared to **CONTROL**. This is due to the fact that as peat was removed, the water table was higher, promoting CH4 production and limiting its consumption.

As a conclusion, **BARE PEAT**, and **SPHAGNUM** treatments promotes plant diversity, but their positive effect on C fluxes are still not observable after 2 (CH_4) and 3 (CO_2) years of monitoring. However, the addition of Sphagnum is advised as it may restore C storing functioning faster than when colonisation is let free to proceed such as in the **BARE PEAT** plots.

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