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

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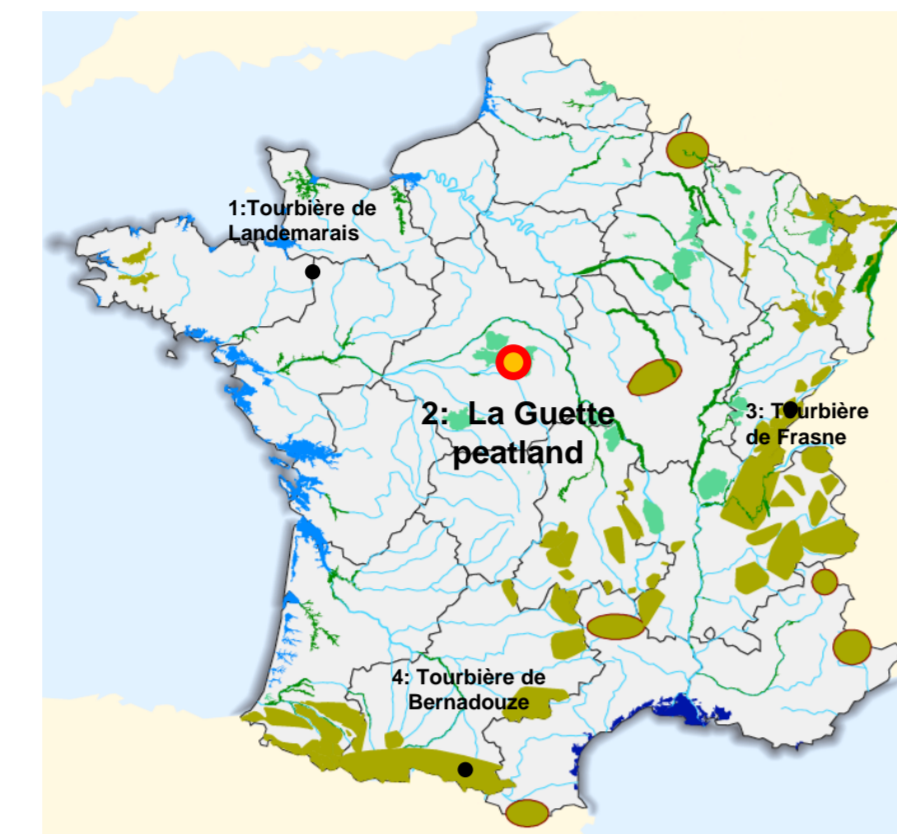
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## A: Aim of the study

*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



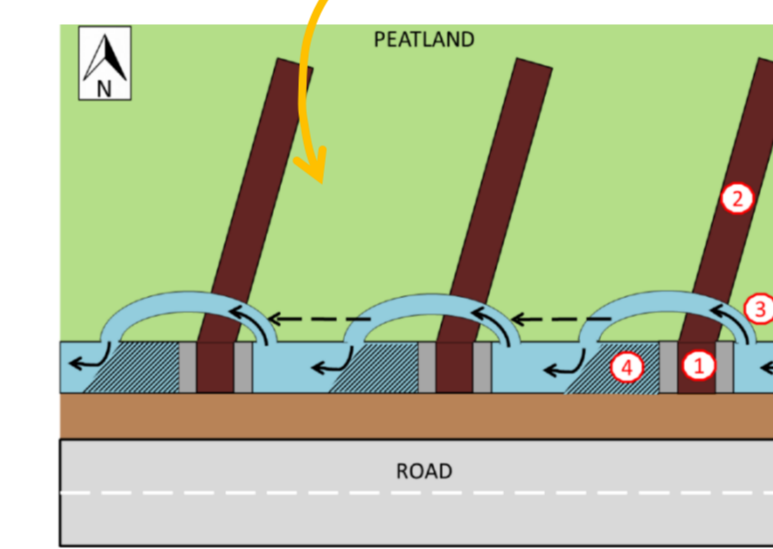
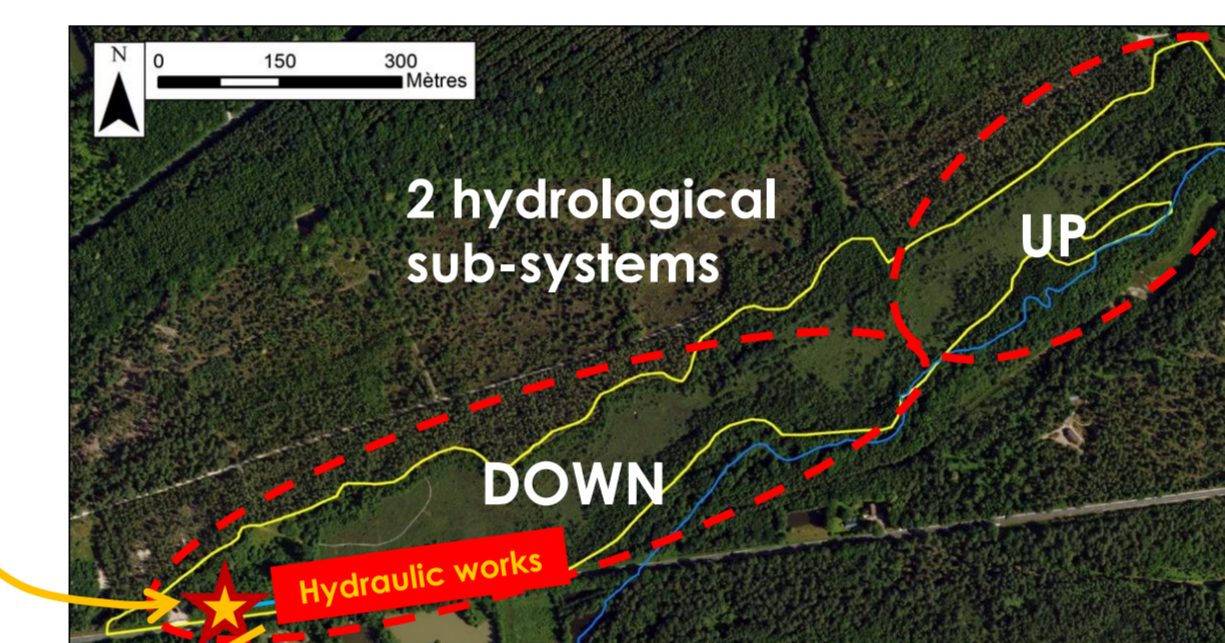
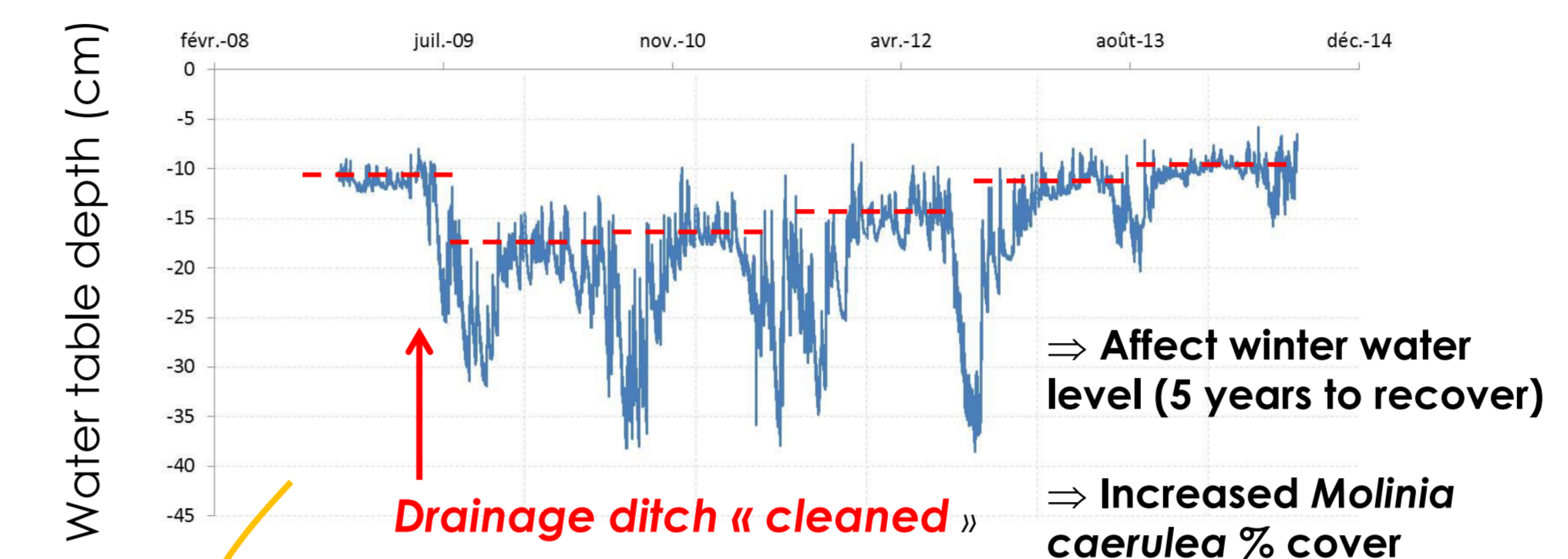
La Guette peatland is in the Centre region, 100 km south of Paris.

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*, *Rhynchospora alba*, *Gentiana pneumonanthe*, *Erica tetralix*.

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



Work done in January 2014

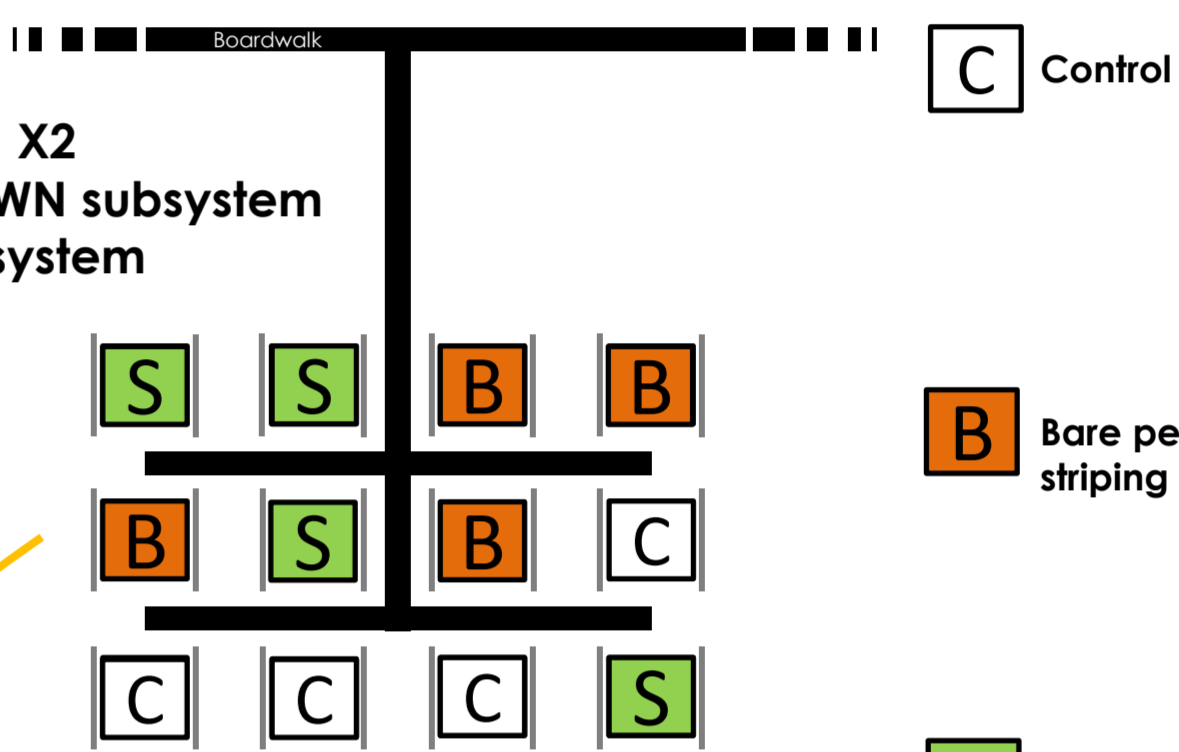
## D: Vegetation restoration experiment

Vegetation treatment that could promote biodiversity and C storing

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

Work done in January 2014

- X2
- 1 in DOWN subsystem
- 1 in UP system

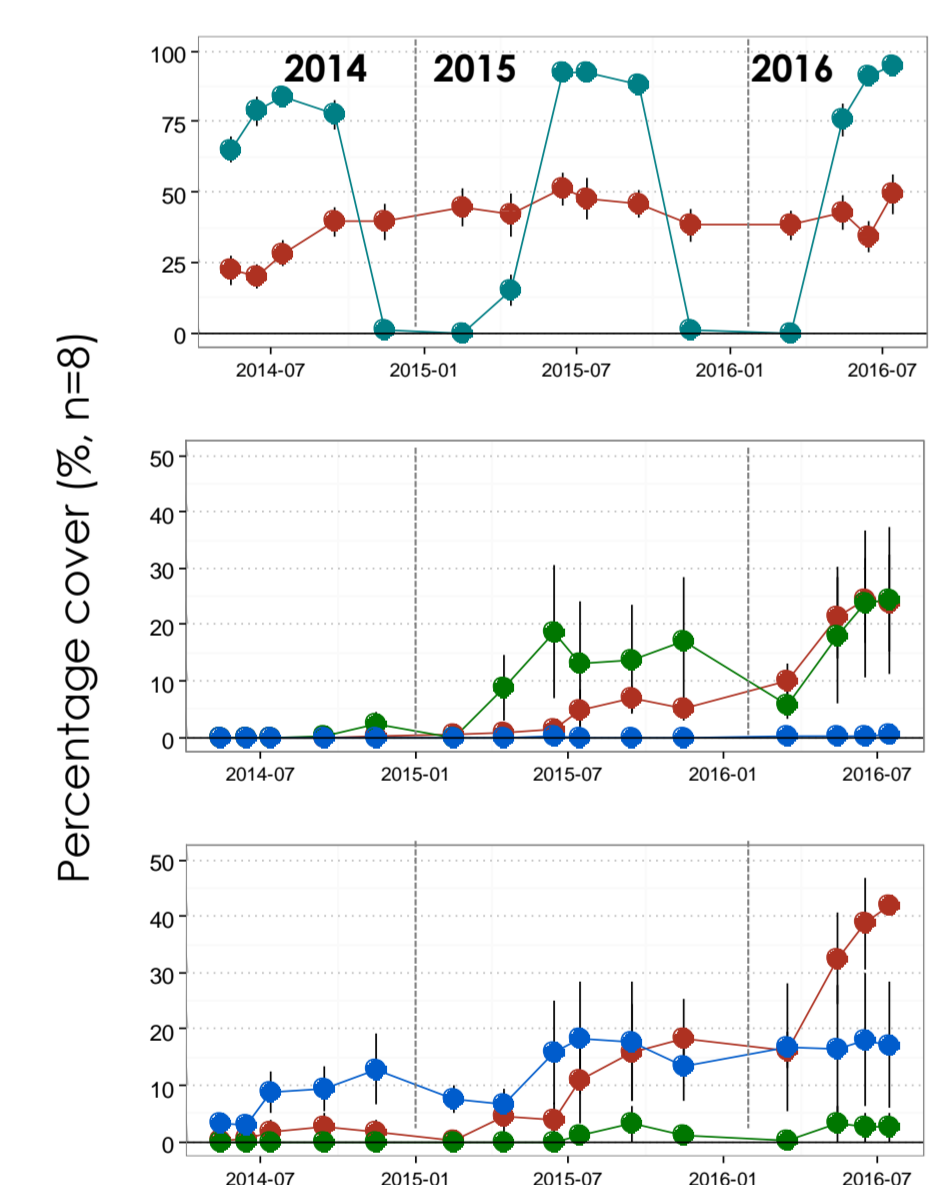


Response variables

- ⇒ Ecosystem respiration
- ⇒ Net Ecosystem Exchange
- ⇒ CH<sub>4</sub> 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

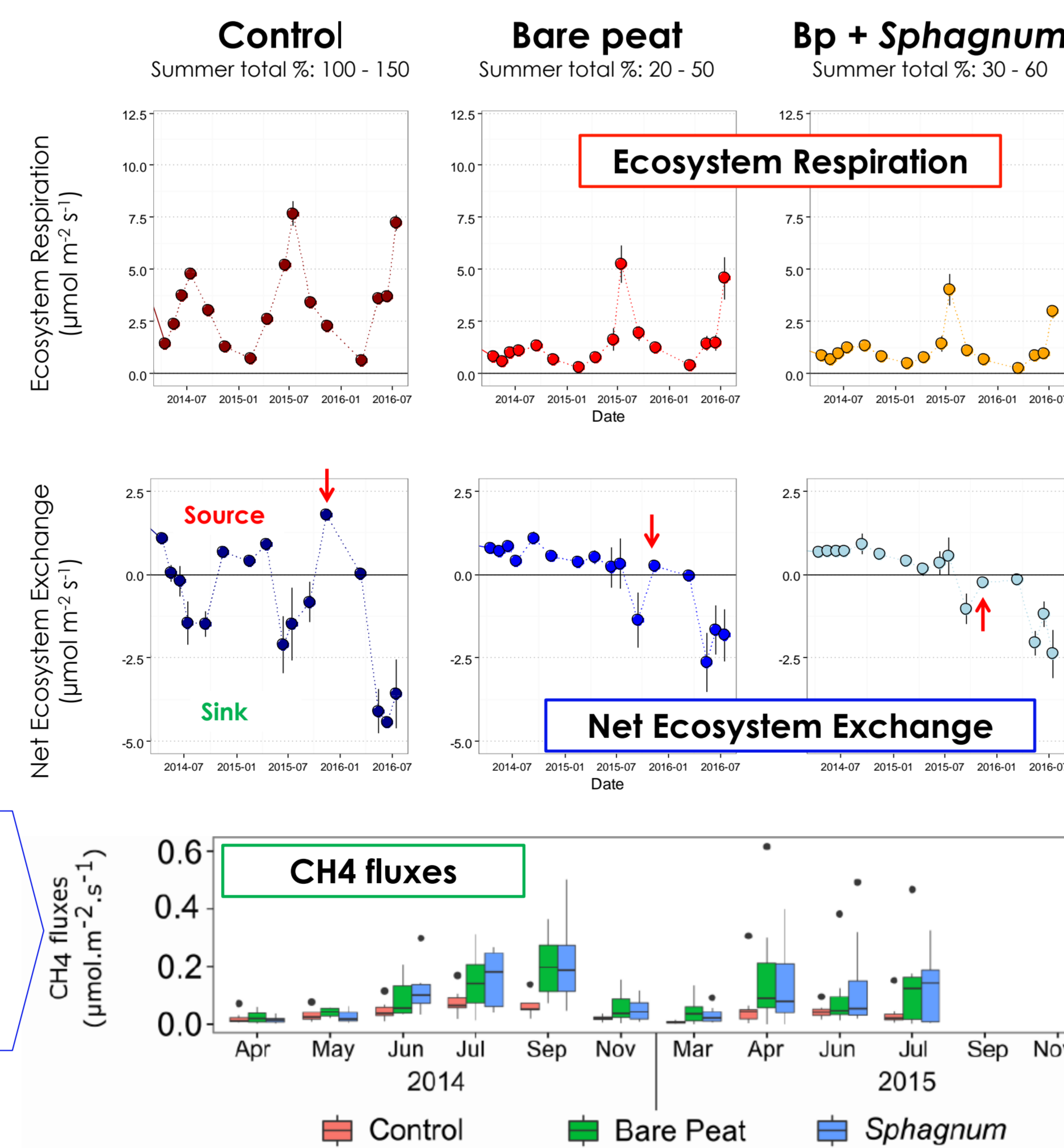
**Bare peat**  
Summer total %: 20 - 50

**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.

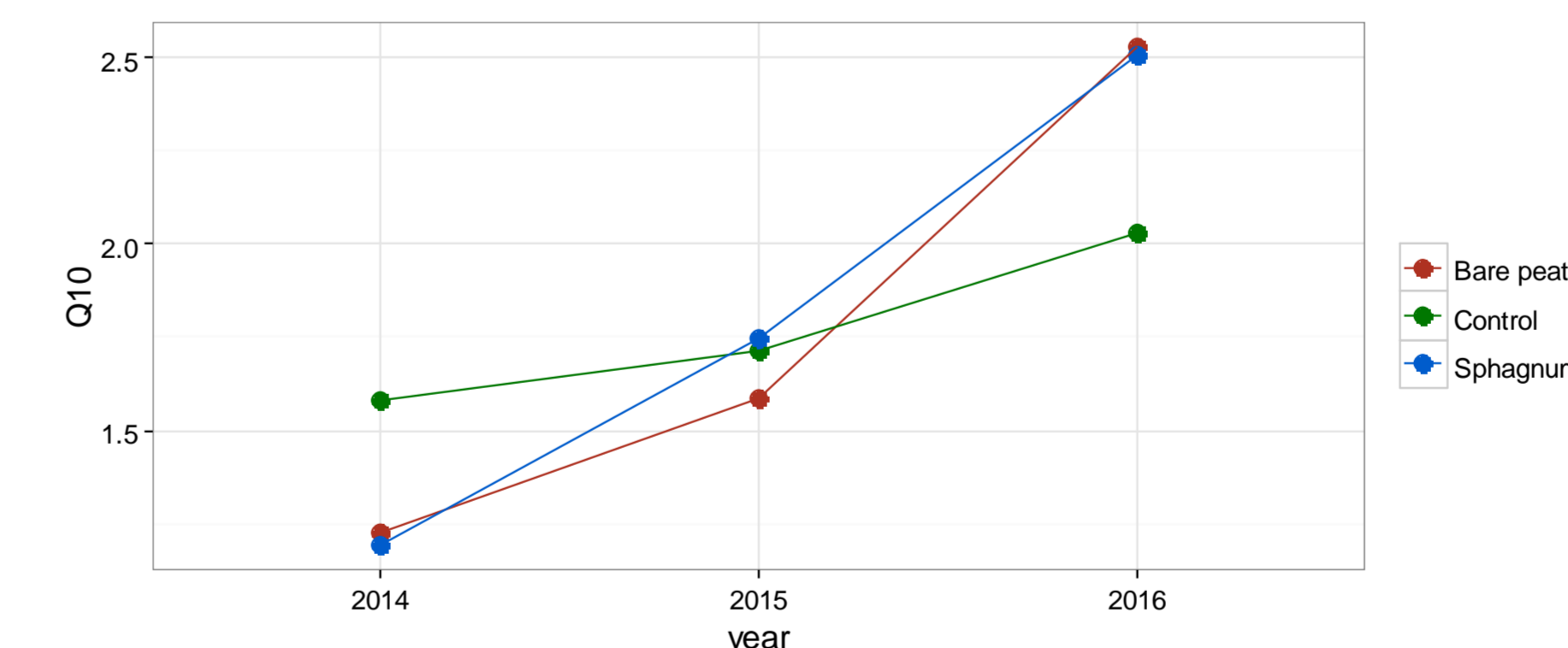
With time, ER and NEE increased in **BARE PEAT**, and **SPHAGNUM** plots. In winter (red arrows), **SPHAGNUM** plots tend to function as a C sink, unlike the other plots. CH<sub>4</sub> fluxes increased in **BARE PEAT**, and **SPHAGNUM** treatments.

Monitoring of CO<sub>2</sub> and CH<sub>4</sub> fluxes



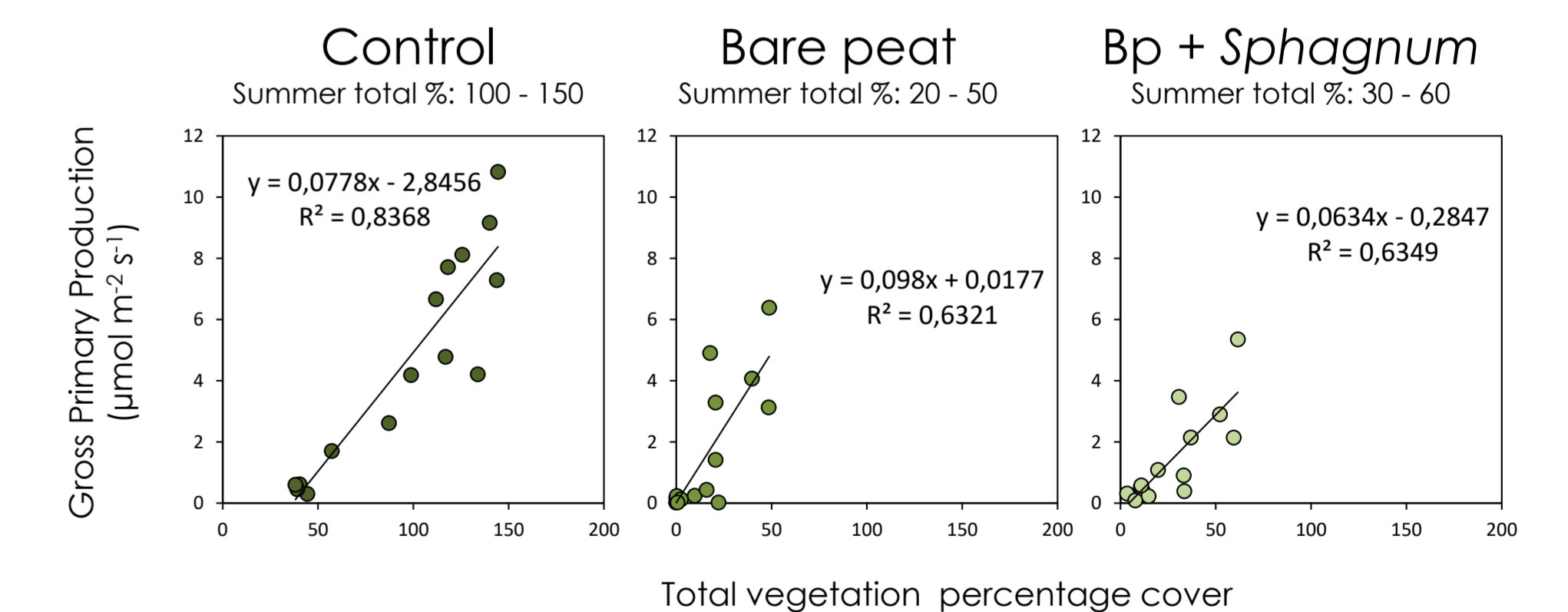
## F: Sensitivity of ER to temperature and GPP to vegetation % cover

Variation of Q<sub>10</sub> of ecosystem respiration with time



Q<sub>10</sub> 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<sub>2</sub> emissions in early colonisation stages can be a negative point of the vegetation restoration.
- Although Sphagnum GPP is less sensitive than other plots to vegetation % cover, this plots were the most efficient to store C in winter.
- Also, the **BARE PEAT**, and **SPHAGNUM** treatments tended to increased CH<sub>4</sub> emissions compared to **CONTROL**. This is due to the fact that as peat was removed, the water table was higher, promoting CH<sub>4</sub> 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<sub>4</sub>) and 3 (CO<sub>2</sub>) 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.