Effect of vascular plants on GHG fluxes in a disturbed peatland.

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Résumé

Sphagnum peatlands are subjected to vegetation change because of hydrological disturbances. Both changes affect greenhouse gases (GHG) fluxes by increased peat oxygenation, litter decomposition and rhizospheric interactions modification. Disturbances can be counteracted by ecological engineering works. Our in situ and experimental works aim to assess the effect of different vegetation on the GHG fluxes in a disturbed peatland (La Guette, central France).
Materials and methods

A biodiversity experiment was implemented in situ and consisted in:

3 treatments (2m x 2m, 8 replications, 24 plots in total):

-"control": intact vegetation (*Molinia caerulea*, *Erica tetralix*)

-"bare" peat: vegetation and 5cm of peat were removed

-"Sphagnum": bare peat+Sphagnum.

CO2 and CH4 fluxes (manual accumulation chamber) were measured 6 times per year with 2 rounds of measurement per day. Air and soil temperature, water table level, soil moisture were monitored.

In addition, 12 peat mesocosms were collected in La Guette peatlands and placed in the ground in Orléans. 6 samples contained only *Sphagnum rubellum* and the others 6 contained *Sphagnum rubellum* and *Molinia*. CO2 and CH4 fluxes were measured, with manual accumulation chamber, every two weeks on average during 14 months. Air and soil temperature, water table level and Dissolved Organic Carbon (DOC) were monitored. The occurrence of *Molinia caerulea* increased the CO2 and CH4 emissions compared to *Sphagnum* alone, while it decreased the amount of DOC. In addition, *Molinia* made the ER less sensitive to temperature, while it increased for the CH4 emission and DOC concentration. In our experiment,

*Intervenant

the presence of *Molinia* increased both ER and GPP with an increased NEE compared to the *Sphagnum*.

Results

After 20 months of recolonisation, more than half of the surface of each plot was covered by vegetation (*Eriophorum angustifolium*, *Rynchospora alba*, *Trichophorum cespitosum*). Both Ecosystem Respiration (ER) and Gross Primary Production (GPP) increased with the amount of vegetation, but they did not reach those measured in the control plot. Relationships between ER versus temperature and GPP versus % vegetation cover showed that bare peat and *Sphagnum* plots were more sensitive to these variables than the control plots. In autumn 2015, the Net Ecosystem Exchange (NEE) measurement showed that the *Sphagnum* plots could function as a C sink while the control and bare peat plot functioned as C source. CH4 fluxes were higher in bare peat and *Sphagnum* plots than in the control.

The results of the mesocosms experiment showed that the occurrence of *Molinia* made the system less sensitive to temperature than *Sphagnum* alone or when plants are colonizing a bare peat. At the same time, it stimulated the total amount of both assimilation and release of CO2. With *Molinia*, the net CO2 uptake was more efficient during the growing season than without. In our experiment, this C uptake seems to be higher than the increased net loss during winter compared to *Sphagnum* or colonised bare peat. For CH4, important losses are expected with increasing temperature. The potential decrease of methanogensis caused by water table lowering by evapotranspiration may not compensate such an increase.

Discussion.
Our in situ and mesocosms experiments suggest that increased length of the vegetation period in the context of climate change, could have contrasting effect on CO2 and CH4 fluxes depending on the relative dominance of vascular (*Molinia* mainly) and a *Sphagnum* species With such complex interactions, predictions on the output of vegetation restoration works on C storing capacity are difficult to establish. Calculating the annual C budget and integrating these data in a model would help to untangle these interactions and to make more accurate predictions.