Carbon budget of a highly aqualysed peatland of the northeastern section of the La Grande river watershed

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1. INTRODUCTION

By studying a large portion of the carbon globally accumulated within the soils, northern peatlands play an important role in carbon dynamics. Yu et al. (2010) estimated carbon stock of northern peatlands at 473-621 Gt C and Moore et al. (1998) assessed that peatlands contribute to diminish atmospheric carbon dioxide (CO2) by 40ppm. Peatlands also represent a source of methane (CH4) to the atmosphere and of dissolved organic carbon (DOC) to the adjacent ecosystems. However, peatlands sensitivity to changes of hydro-climatic conditions can lead to a switch of the annual C budget from sink to source and can modify CH4 emission to the atmosphere (Griffis et al. 2000; Ruellet et al. 2007).

In northeastern Canada, the increase of atmospheric humidity registered in the last 700 years lead to a rise of the regional water tables (Arten-pouliot, 2008). This disequilibrium of the hydrological conditions generates gradual decomposition of the strings and pool fusion. This evolution of the peatland leads to an increase pool density at the expense of the vegetated surfaces. We refer to this phenomena by the neologism ‘aqualysation’ (Dissouzaa et al. 2009).

The main objective of this study is to document the influence of a high water table and a large proportion of pools on the carbon budget of a peatland. To understand the indirect role of aqualysation on carbon balance, we analysed the influence of environmental variables on CO2 and CH4 fluxes across microtopographical gradients. The final objective of this study is to generate a C budget at the peatland scale for 2 years in an aqualysed peatland using measured and modelled data of CO2, CH4 and DOC in order to document northeastern canadian region where a rise of humidity is historically documented and projected in the next decades following the Canadian Regional Climate Model scenarios (Plummer et al. 2010).

2. STUDY AREA AND SITE

The study area is located at the ecotonal limit of subarctic and boreal ecoclimatic regions in the northeastern portion of the La Grande river watershed. The studied peatland has been chosen after a regional survey and landscape characterization of the region in 2008. The peatland (Abeille peatland) is a poor aqualysed (42%) oligotrophic patterned fen located 15km from LaForge-I hydroelectric infrastructure (54° 06.9’ N, 72° 30’.1’W). The peatland (5.3 ha) is covered by elongated parallel pools interspersed by strings perpendicular to the general direction of the slope. Pool depth ranges between 10-300cm with an average of 108cm (Pouds-Mc Linnis, 2010).

3. METHOD

Seven campaigns of respectively 10 days each were realised over 2009 (4) and 2010 (3) growing seasons. CO2 and CH4. Level loggers (Odyssey Capacitance Water Level Loggers) were installed to measure the water table fluctuations and HOBO probes (TMC6-HD Air/Water/Soil Temp Sensor) were installed to measure the peat temperature at 4 depths (5, 10, 20, 40cm) for every terrestrial (T) and aquatic (A) microsites.

Net ecosystem exchange (NEE) was measured using a climate-controlled static chamber under different photosynthetically active radiation (PAR). CH4 fluxes were sampled using a foil covered static chambers and analysed with a gas chromatograph Shumadzu 2010C. 2994 CO2 fluxes and 291 CH4 fluxes were used for terrestrial surfaces and 89 CO2 fluxes and 92 CH4 fluxes were kept for pools.

4. RESULTS AND DISCUSSION

4.1 Annual C budget

• NEE showed important spatial variability. Hummocks presented highest NEE while hollows presented the lowest (Figure 4). Pool fluxes were similar to those of the hollows but were unidirectional to the atmosphere.

• For the terrestrial surfaces, 2009 growing season was a net source while 2010 was a small sink. This variability can be explained by a change in the hydroclimatic conditions during the growing seasons. 2009 was a dry and warm year which lead to high respiration rates and limited photosynthesis. 2010 growing season was wet and warm which lead to higher rates of photosynthesis. However, the CO2 sink was offset by pool fluxes to the atmosphere (Figure 5).

• CH4 fluxes presented an important spatial variability. Highest fluxes were measured in microforms with water table close to peat surface and pool fluxes were in average 5 times higher than terrestrial fluxes. Fluxes were statistically similar between 2009 and 2010 (Figure 5).

• As CH4 fluxes strongly correlated with peat temperature at 5 cm, annual CH4 contribution of the peatland was modelled using this variable.

5. CONCLUSION

Aqualysed peatlands concentrated in northeastern Canada at the ecotonal limit of the boreal and subarctic ecosystems, showed a net carbon loss towards the atmosphere during the 2 years of measurements mainly because of 3 variables : the cold season represent a long period of C loss, during the short growing seasons, dry conditions can reduce photosynthesis and increase respiration rates and CH4 emission. The high pool cover represent a net source of C with high CO2 and CH4 fluxes to the atmosphere. Aqualysed peatland is and will continue to be a source of carbon, the magnitude of which will mostly be controlled by hydro-climatic conditions during the growing season.

6. REFERENCES


7. ACKNOWLEDGMENTS

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