Effect of the soil degradation degree on CO_2 emissions in cultivated peatland

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INTRODUCTION

- In Quebec, a large proportion of vegetables are grown on **cultivated peatland**.
- **Drainage** of these soils favors **peat mineralization,** which contribute in part to annual soil losses of **1 to 5 cm** and **CO_2 emissions.** This leads to **soil degradation** and a **significant decrease in agricultural productivity.**
- Efforts to establish **soil conservation strategies** require knowledge of the **intensity level of CO_2 emissions** related to the **physicochemical properties** of soils.

Objective :

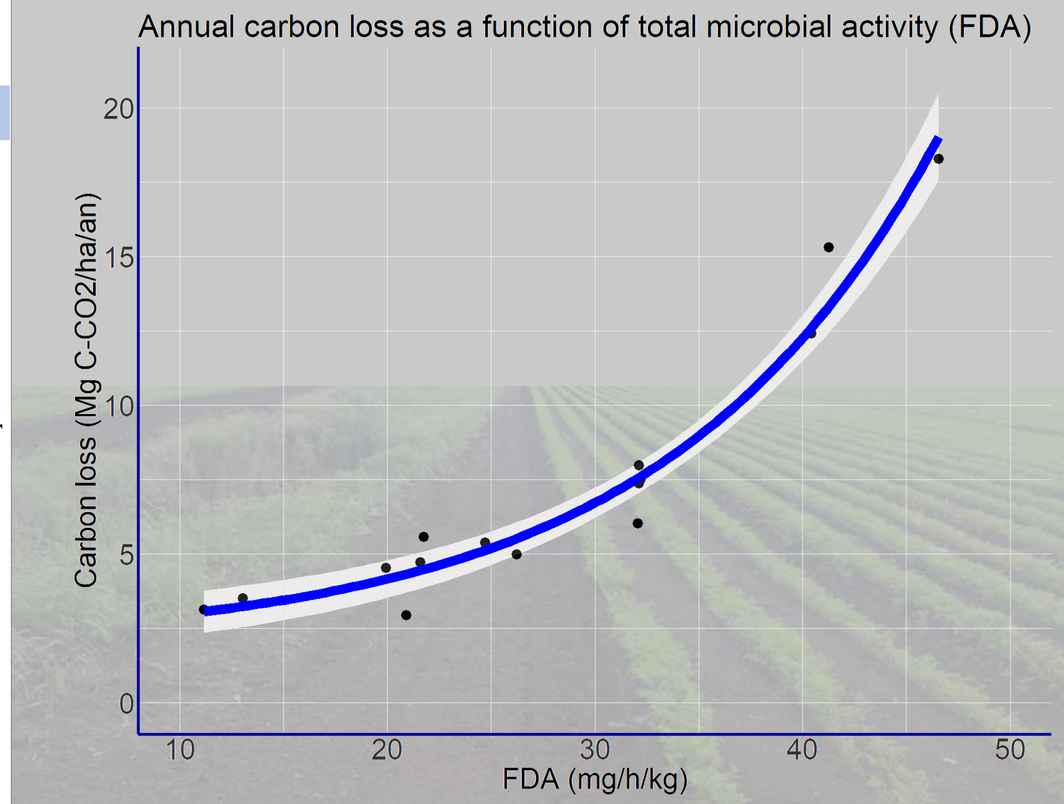
Quantify the carbon loss through mineralization of cultivated peatland and identify the physicochemical parameters that influence CO_2 fluxes.

MATERIALS AND METHODS

- **Gas fluxes** emitted from the soil were measured using the **static chamber**-based method from September 2021 to September 2022.
- **Field experimentation** was conducted in **cultivated peatland** of southwestern Quebec.
- **Five sites** (F1 to F5) **were selected** based on their organic matter content to represent a wide **range of soil degradation levels.**
- Four of the sites were **bare,** and one site had **miscanthus vegetation** (F3).
- A characterization of the sites was carried out, and several physicochemical soil properties were measured **every 2 or 3 weeks.**
- Losses of carbon through mineralization were converted **into a loss of soil height**.

Cultivated peatland lose an average of **0.61 cm yr^{-1} of soil** through mineralization of organic matter in the form of **CO_2 emissions.**

In these soils, **total microbial activity (FDA)** could predict soil loss by being **correlated with carbon emissions.**



RESULTS

Graph 1: Carbon flux as a function of time for the 5 farms

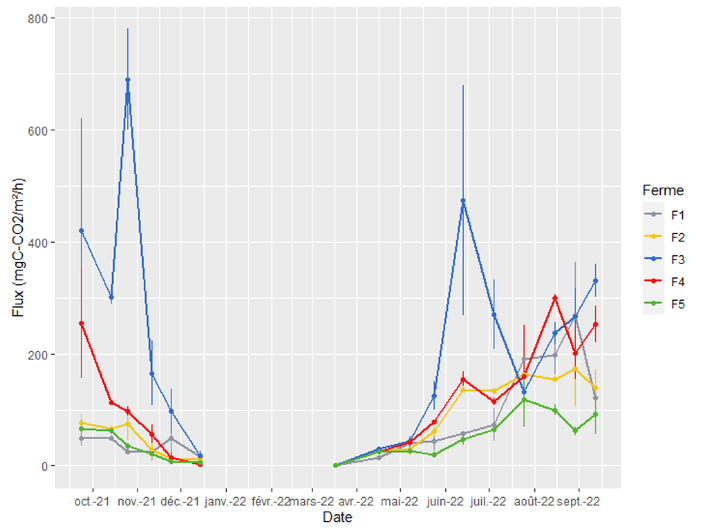


Table 1: Mixed linear regression of the influence of edaphic parameters on temporal carbon fluxes

	Estimated	Std error	Pr(>|t|)	
(Intercept)	-7.21E-01	5.99E-01	0.23561	
Organic matter	-6.99E-03	4.39E-03	0.12593	
Soil temperature	2.08E-02	6.43E-03	0.00142	**
Soil water content	-1.18E-02	3.14E-03	0.00022	***
Air temperature	2.42E-02	4.20E-03	3.39E-08	***
Labile carbon	9.01E-06	3.75E-06	0.0172	*
N	3.83E-01	1.45E-01	0.00925	**
pH	1.68E-01	7.98E-02	0.04479	*
Electric conductivity	2.45E-04	2.74E-04	0.37351	

CONCLUSIONS

- Carbon losses through mineralization of cultivated peatland **vary significantly** according to **edaphic parameters** and the **presence or absence of vegetation.**
- Annual fluxes vary from **3.2 to 15.3 Mg C-CO_2 ha^{-1} yr^{-1} .**
- Considering that organic soils lose an average of 2 cm yr^{-1} in height, the mineralization of organic matter contributes to **30% of soil losses.**
- **Further experiments** would enable **predictive models** to be established to **estimate carbon losses** at field level as a function of edaphic and meteorological parameters.
- Knowing the extent of carbon losses will help to find soil conservation strategies, such as replacing carbon loss through the **amendment of carbon-rich biomass.**

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