

EM - 1 PROJECT



*Reservoirs' net greenhouse
gas emissions research project*

Investigating pre-impoundment terrestrial carbon stocks and fluxes in the Eastmain-1 reservoir area, James Bay, Québec, Canada

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Context

- Eastmain-1 project:
 - Determine the impact of reservoir creation on GHG emissions by comparing natural ecosystems fluxes prior to flooding with post-flooding GHG emissions.
- World premiere on a hydro-electric reservoir
- Other study: ELARP (Kelly et al., 1997)
 - Boreal forest wetland in northwestern Ontario, Canada
 - Small scale - 0.16 km² experimental site



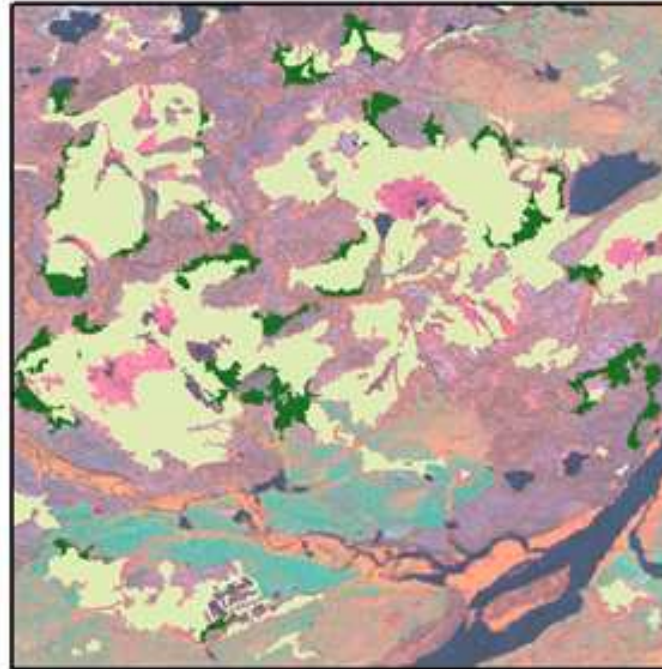
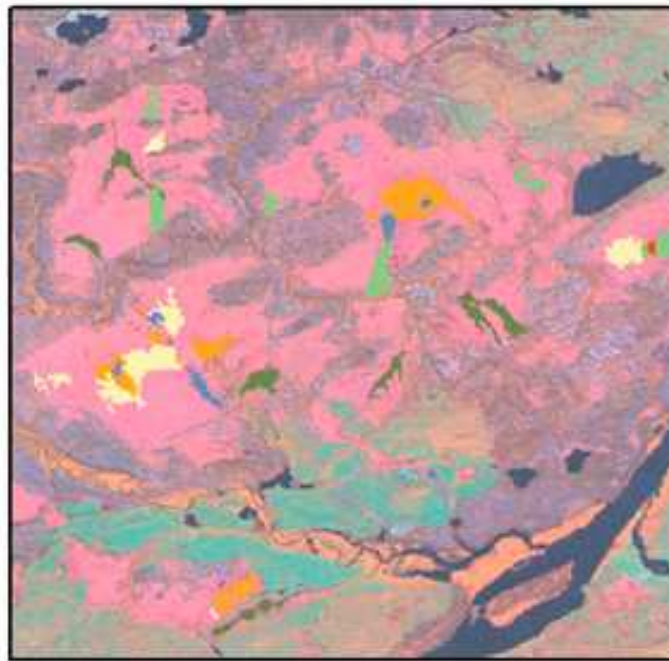
Objectives

- Determine pre-impoundment terrestrial C stock and flux budgets for the EM-1 reservoir area.
 - Spatial variability
 - Forest stand types (C stocks and fluxes)
 - Peatland (C stocks and fluxes) and microtopography (fluxes)
 - Temporal variability
 - Seasonal and interannual (fluxes)



Forest and peatland mapping

- Object-based classification using



POOLS

- BOG : low density pool complex
- BOG : high density pool complex
- BOG : isolated pool
- FEN : low density pool complex
- FEN : high density pool complex
- FEN : isolated pool

STRUCTURE OF VEGETATION COVER

- TREED BOG
- OPEN BOG

vegetation cover

- | | |
|---------------------------|------------------------|
| Forêt fermée de conifère | SRAF ancien |
| Forêt ouverte de conifère | SRAF récent |
| Eau profonde | Sol nu / Non forestier |
| Forêt de feuillus | Terre humide |



Grenier et al. 2008



Environnement
Canada

Environment
Canada

Service canadien
de la faune

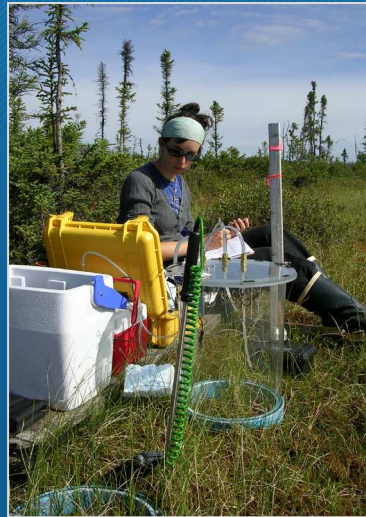
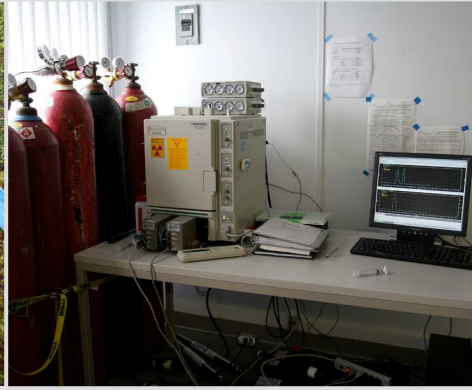
Canadian
Wildlife Service



Peatland ecosystems

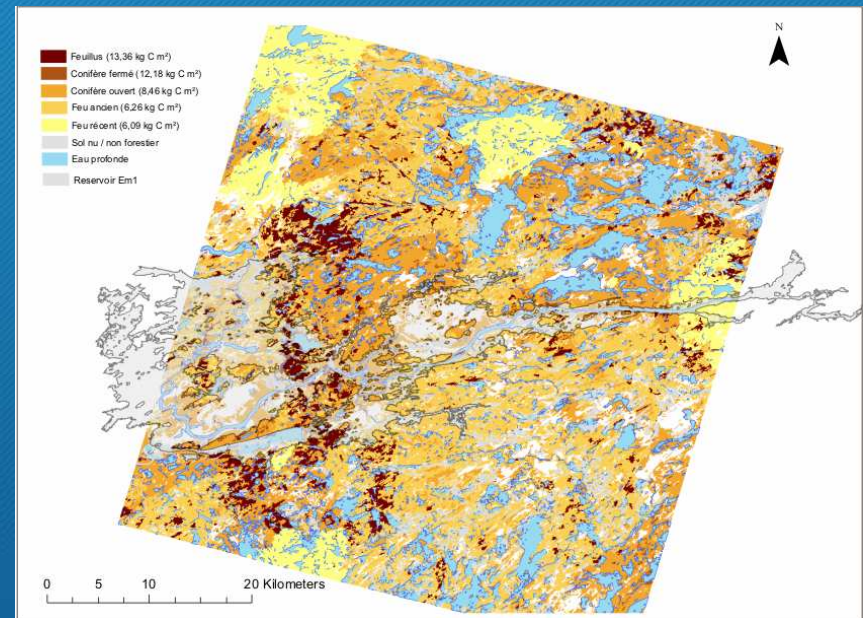


Methods



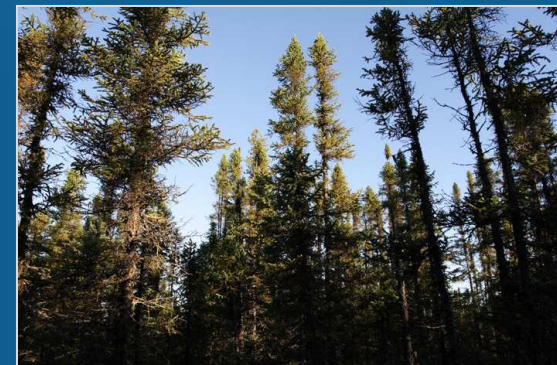
Forest carbon stock

Stand Type	C Stock		Stand Type Coverage (km ²)
	kg C m ²	+/-	
Open Coniferous	7.6	4.6	164
Closed Coniferous	11.2	5.8	2.6
Deciduous	13.6	4.2	15.6
Burned (18yrs)	6.1	0.8	6.1
Burned (2yrs)	5.8	2.5	107.7

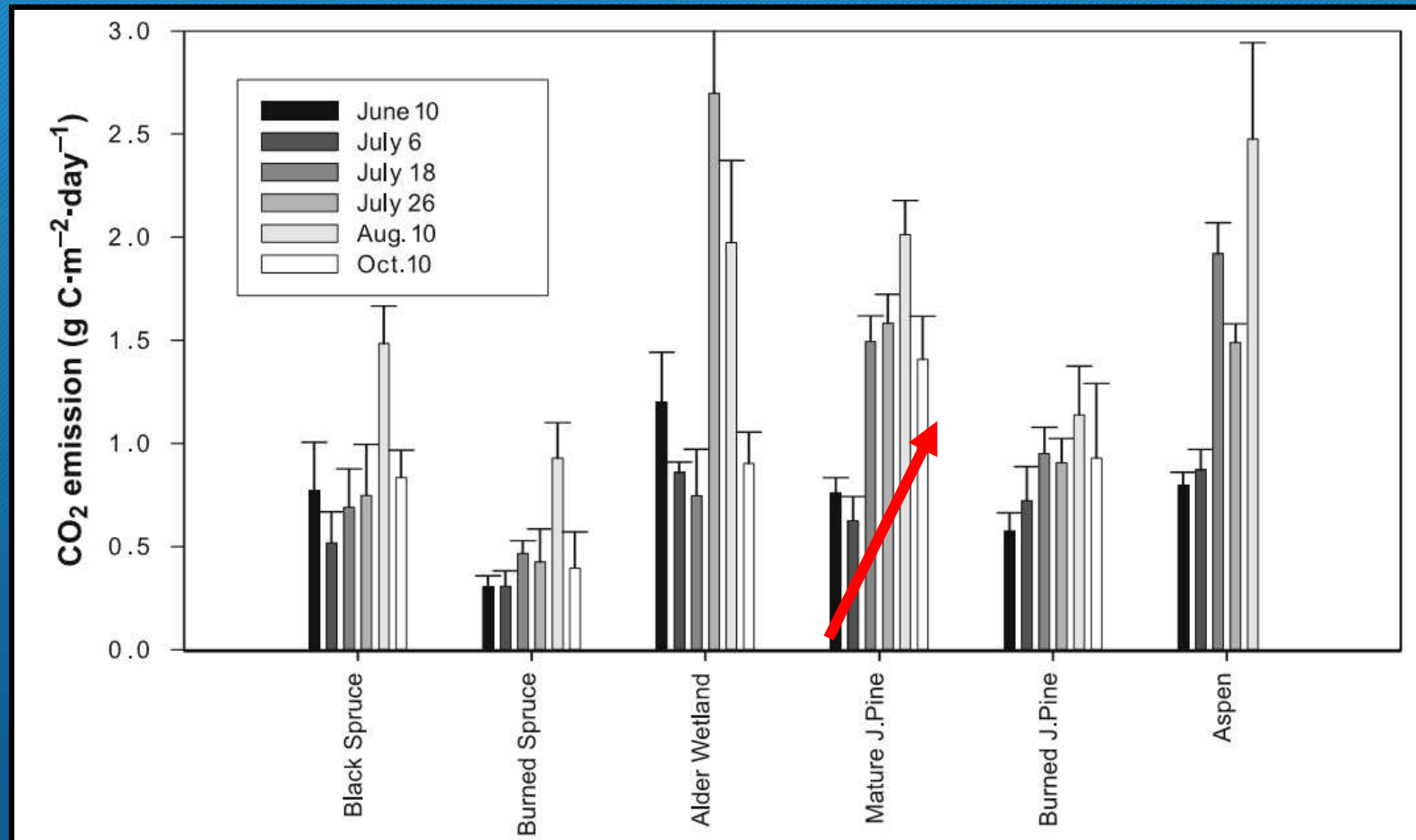


- Mean C stock : 7.26 kg C m²

Banville et al. (submitted)



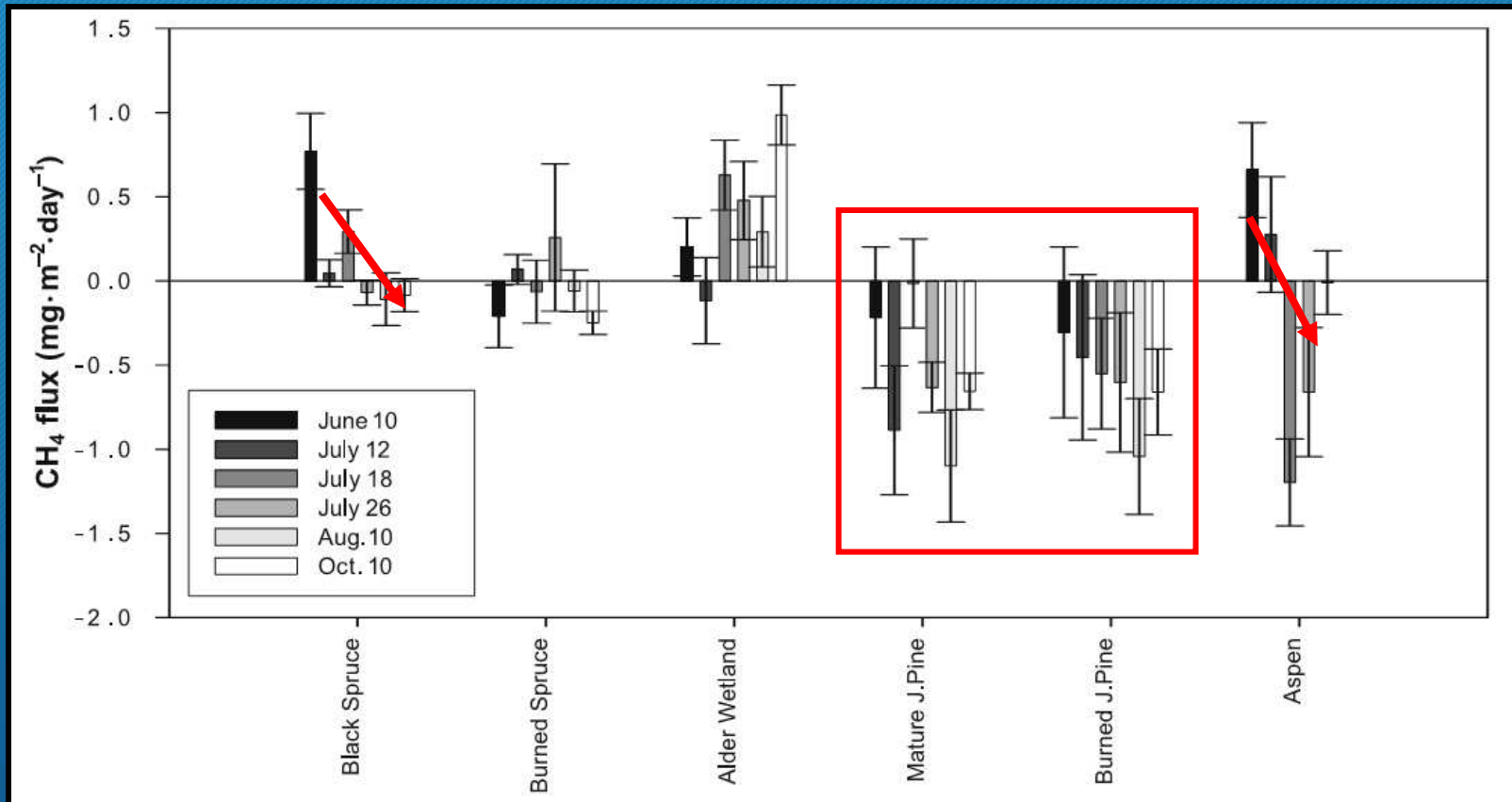
Forest soil CO₂ fluxes (respiration)



Ullah *et al.* 2009



Forest soil CH₄ fluxes



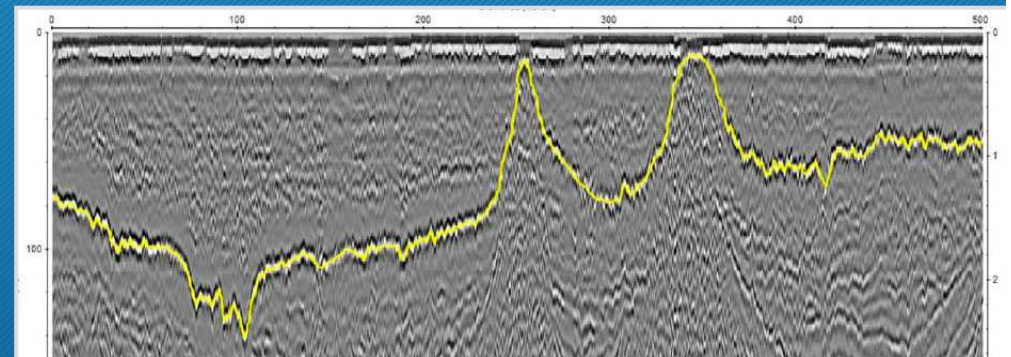
Ullah *et al.* 2009

Annual budget: -0.08 g C m⁻² yr⁻¹



Peatland carbon stock

- Peatland basin topography



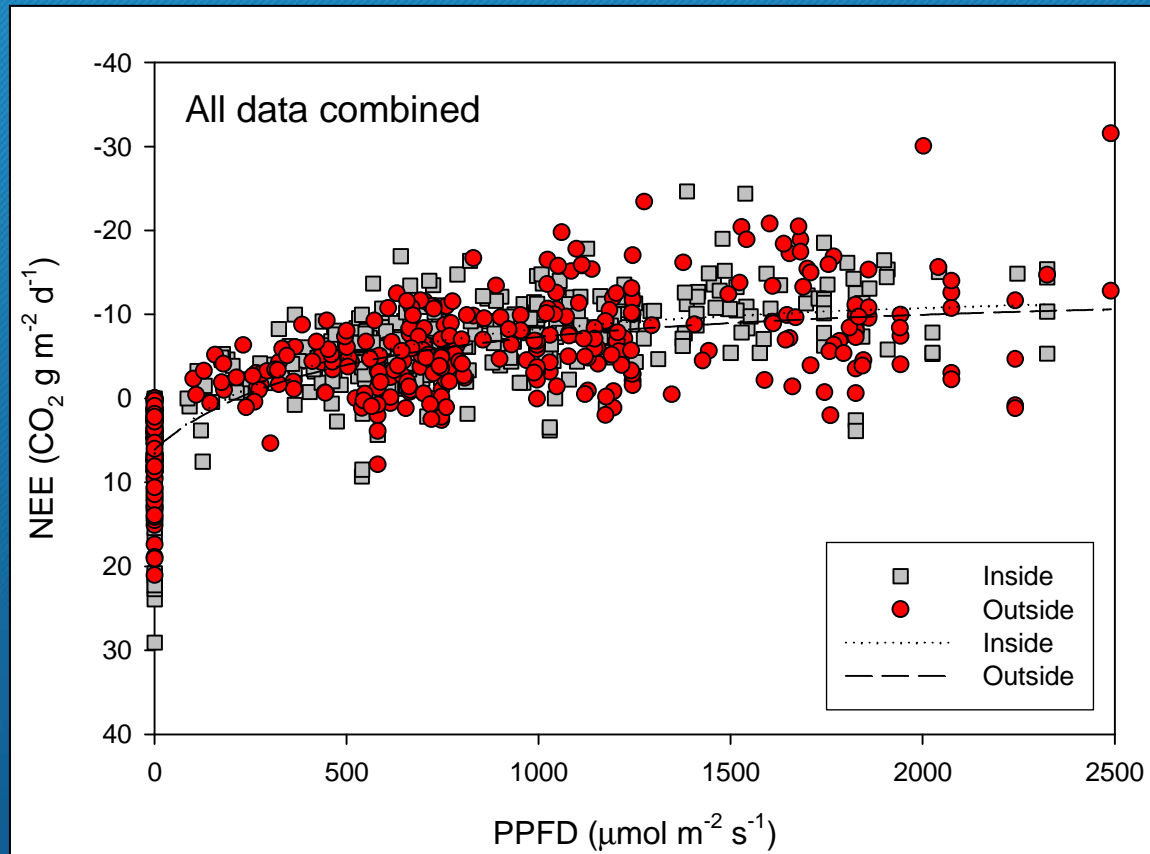
Dallaire et al. (2008)

Mean C stock : 98 kg C m^2

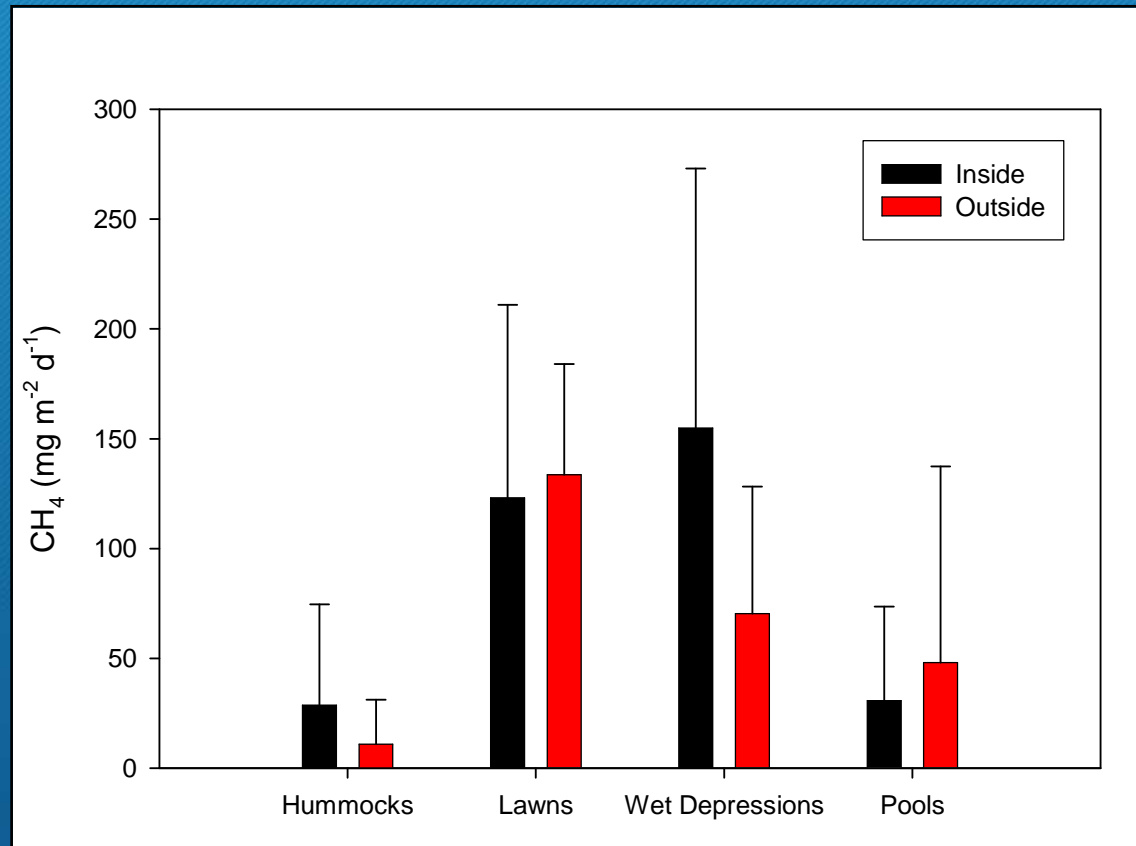
Van Bellen et al., Submitted



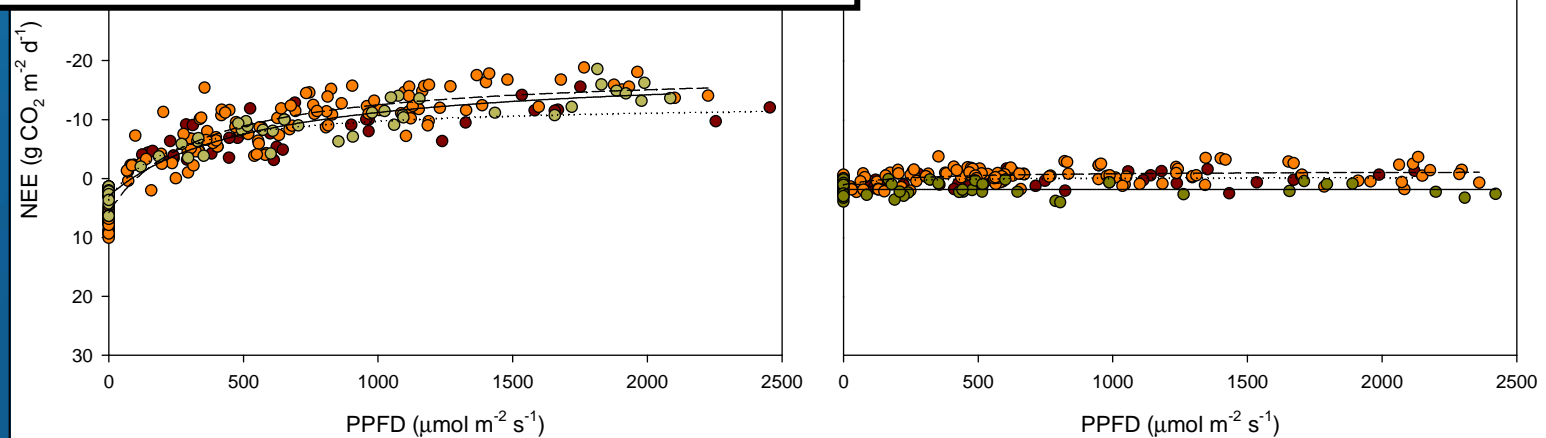
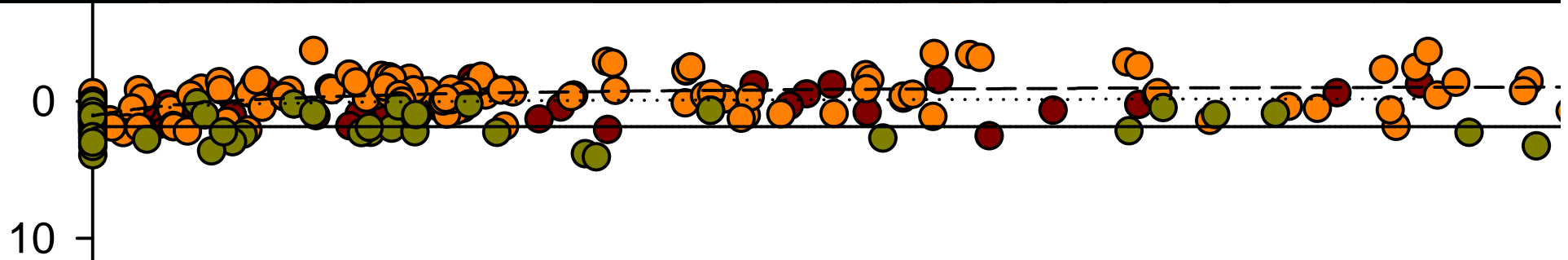
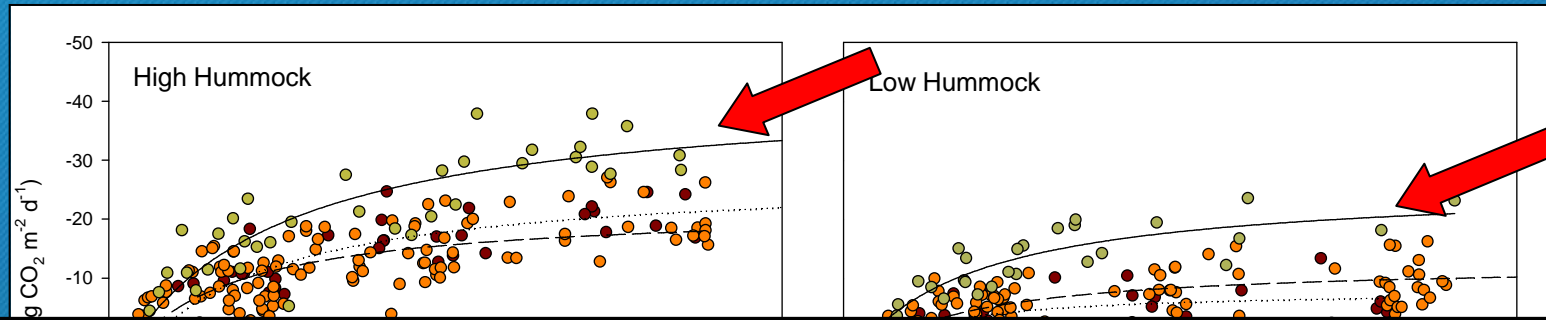
Overall Net Ecosystem Exchange results (2005)



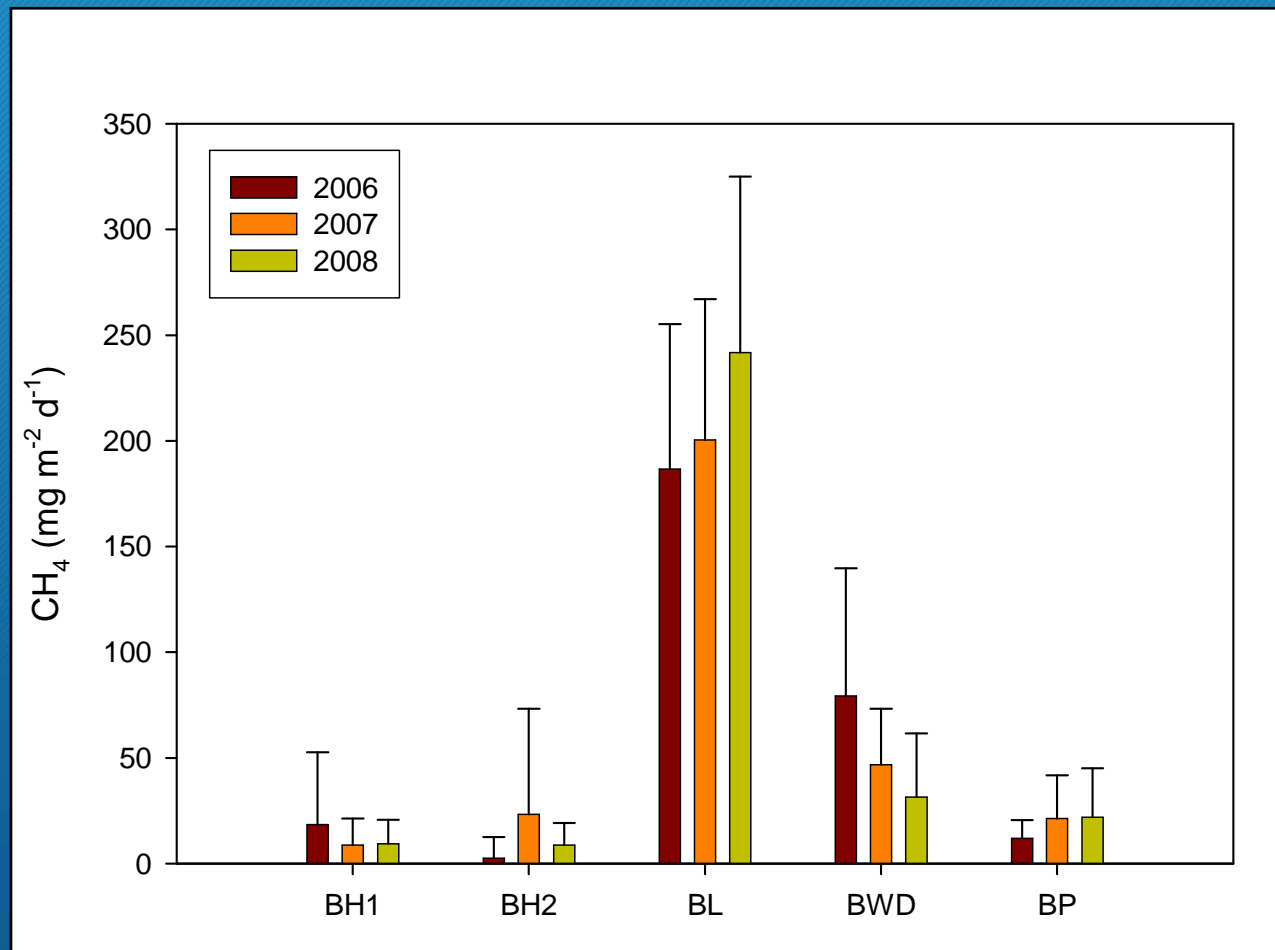
Inside/outside peatlands comparison: CH₄ fluxes



Bog NEE/PPFD relationship variations 2006-2008

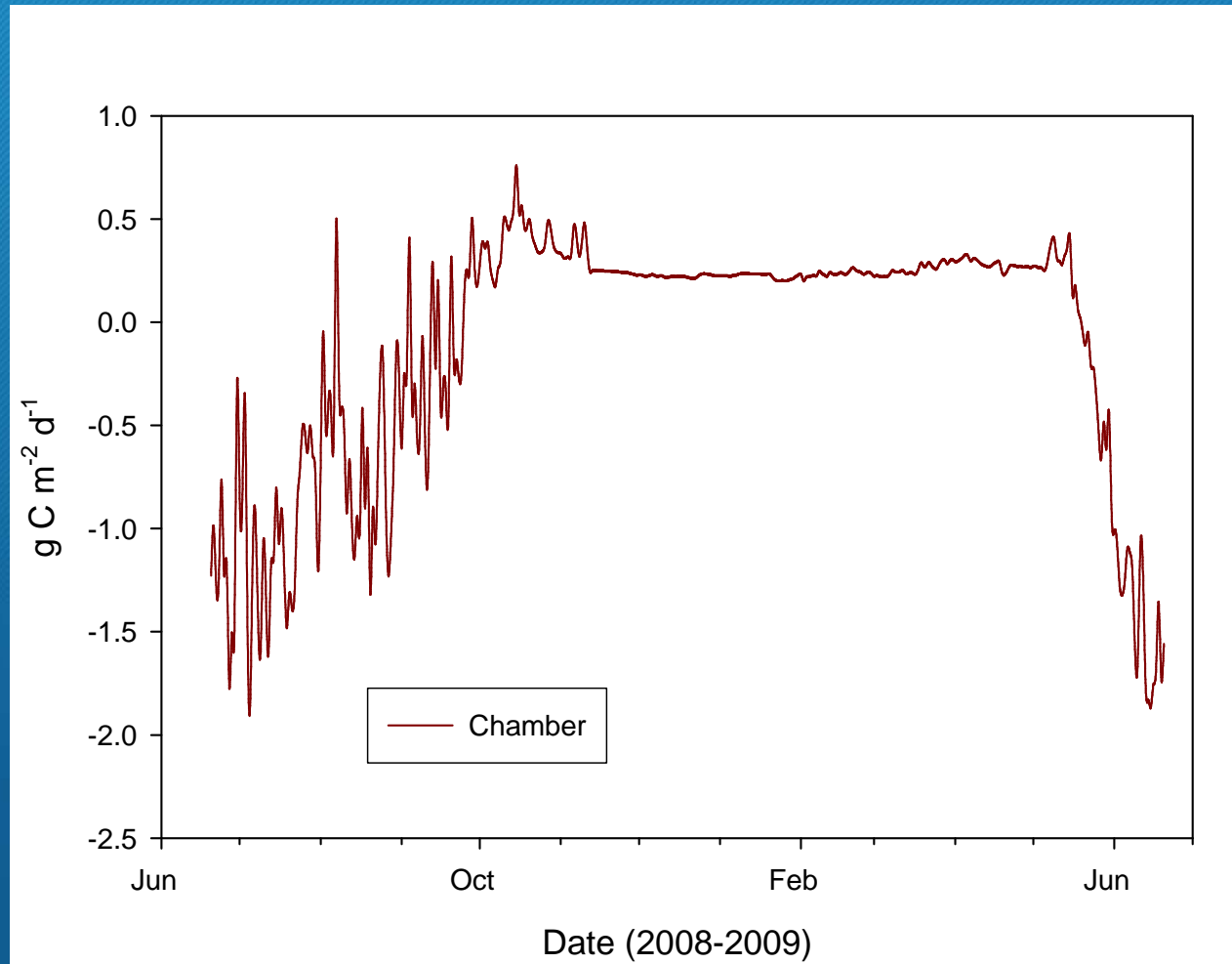


Bog CH₄ flux variations 2006-2008

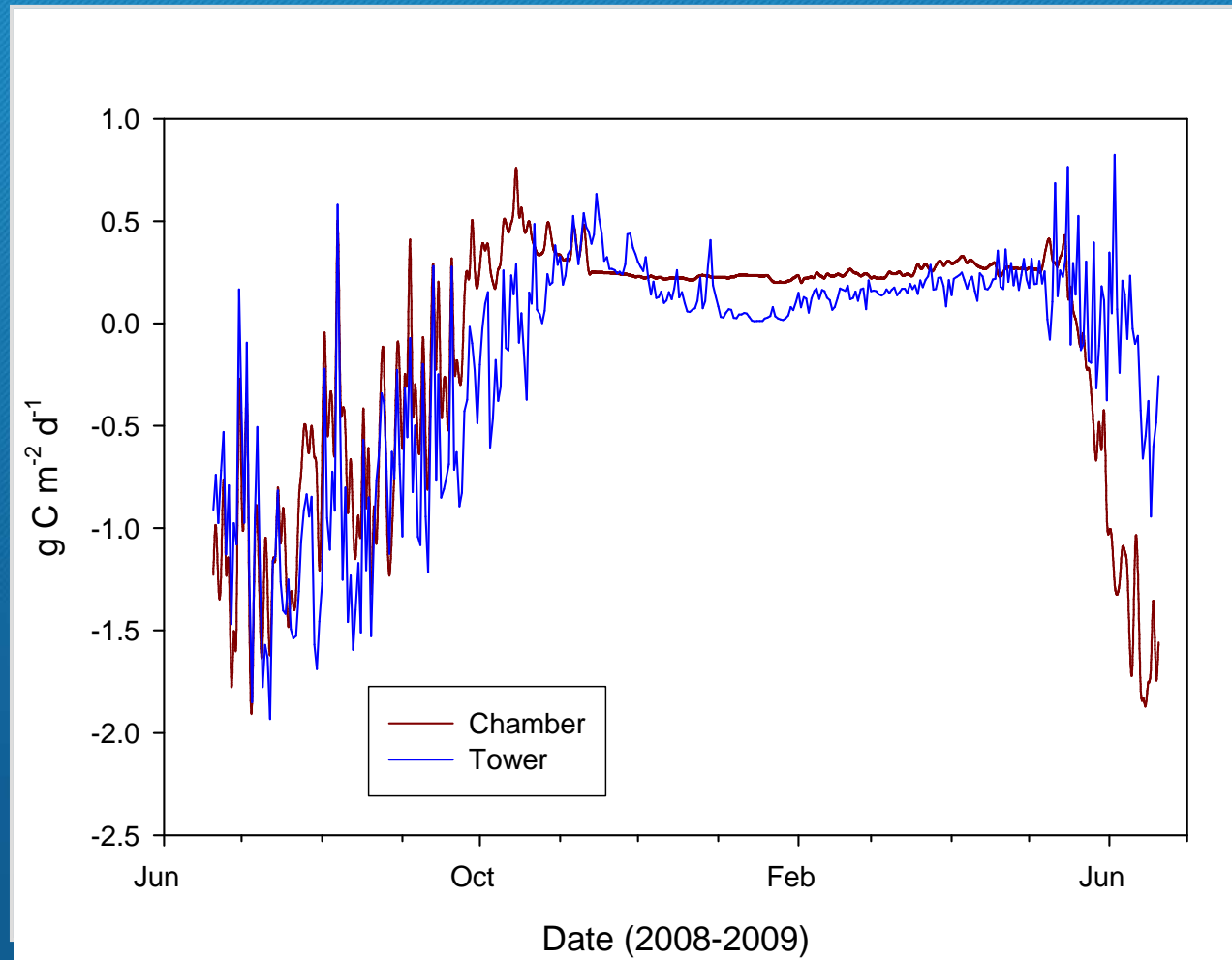


Eastmain-1 peatland CO₂ budget

Modelling Chamber Net Ecosystem Exchange



Eastmain-1 peatland CO₂ budget Eddy covariance - Net Ecosystem Exchange



Peatland C accumulation rates: method comparison

- Eastmain-1
 - Long-term accumulation : $23 \text{ g C m}^{-2} \text{ yr}^{-1}$
 - Chamber : $37 \text{ g C m}^{-2} \text{ yr}^{-1}$
 - Tower : $55 \text{ g C m}^{-2} \text{ yr}^{-1}$
- Other peatlands in Québec:
 - Long-term accumulation : $18 - 30 \text{ g C m}^{-2} \text{ yr}^{-1}$
(Garneau *et al.*, 2009, Gorham *et al.*, 2003)



Conclusion

- This study provides the first pre-impoundment C budget of terrestrial environments in the context of a hydro-electric reservoir project
- Peatland C stocks and fluxes correspond to data from other sub-arctic and boreal sites
- Importance of considering peatlands in terms of C stock and fluxes in hydro-electric reservoir projects



Acknowledgements

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