

Eastmain-1 Project

Aquatic portion
2006 field season

UQAM team

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Objectives

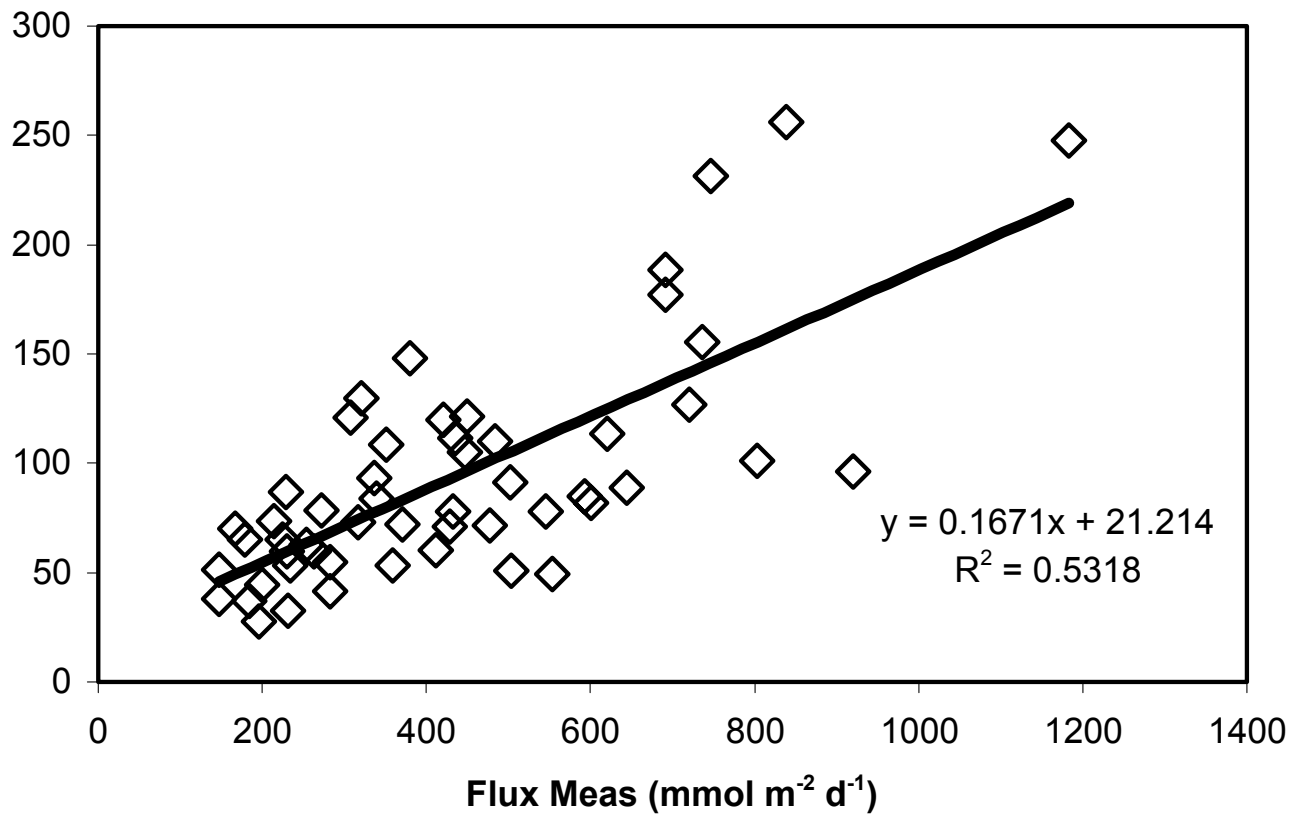
- Review general conclusions from previous meeting
- Review comparison of pre- vs post-impoundment measurements on Eastmain-1 reservoir
 - Nutrients, DOC, carbon fluxes
- Origin of the effluxing CO₂
- Controls on the pCO₂ in boreal systems: are they different from temperate lakes

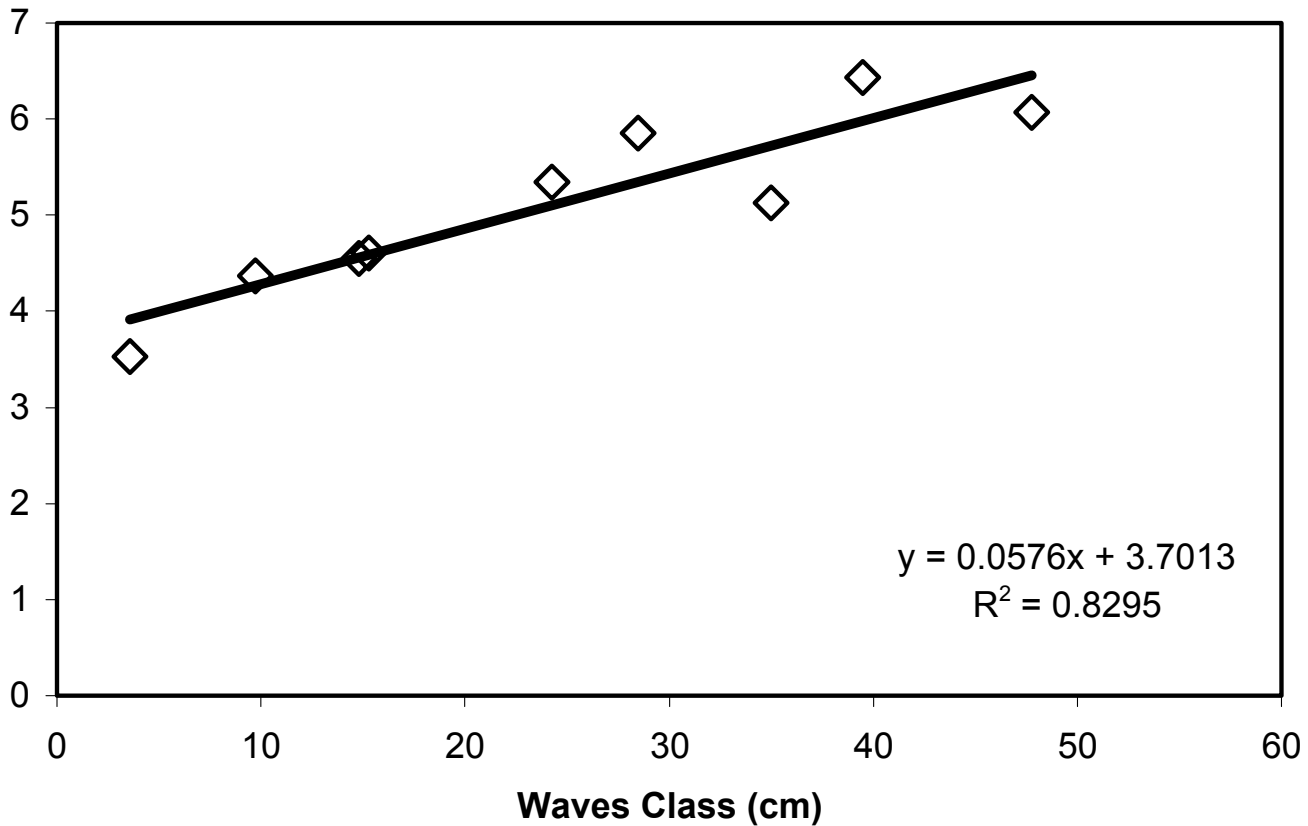
Reservoir effect?

Conclusions

- Floating chambers overestimate true flux by a factor of about 4
- There is a strong reservoir effect on phosphorus and $p\text{CO}_2$
- Not all excess CO_2 is of pelagic metabolic origin.
- CO_2 emissions appear to be increased by a factor of 20X compared to the pre-flooding aquatic contributions (small streams excluded)

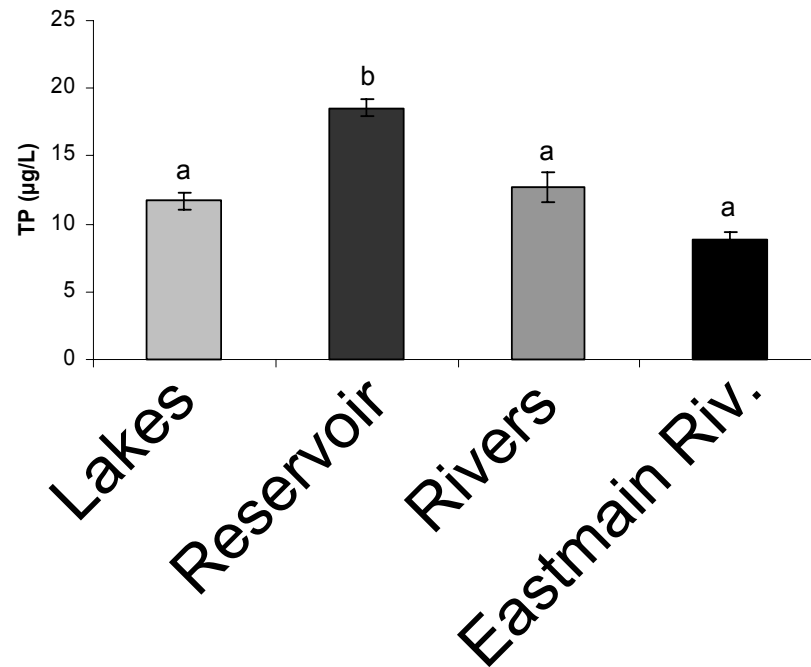
Floating chambers overestimate
true flux by a factor of about 4



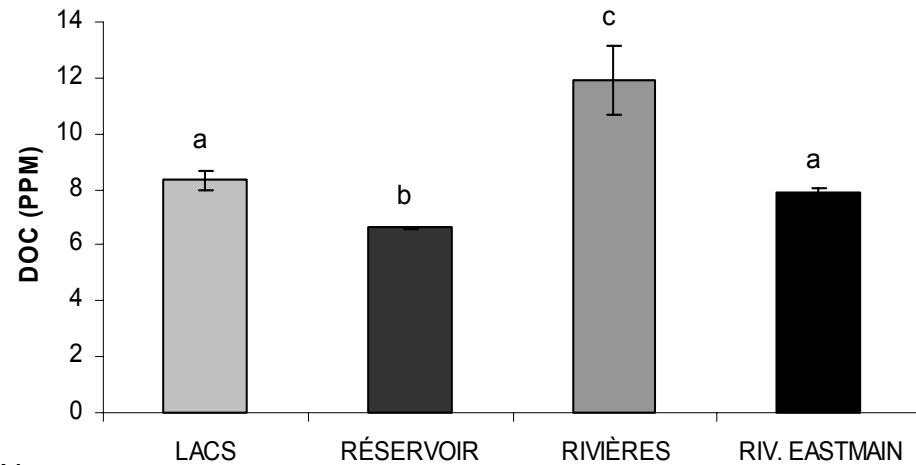
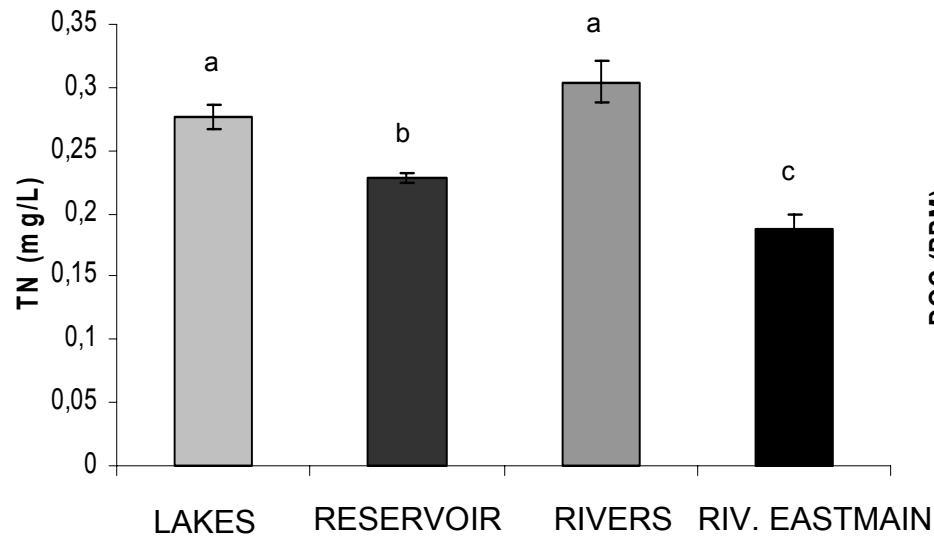


Caution: floating chambers overestimate flux by a factor of about 4

There is a strong reservoir effect on phosphorus



but a negative one on DOC and nitrogen



pCO₂

QuickTime™ and a
None decompressor
are needed to see this picture.

Where does it come from?

Possible explanations for increased $p\text{CO}_2$

- No change in substrate, just a change in exchange velocity at the interface
- Simple change in depth
- Release of organic matter from the flooded soils to the water column and subsequent pelagic mineralization
- Flooded soil *in situ* OM mineralization and gas diffusion to water column

Change in exchange velocity k

- From the literature
 - Rivers : 5 m d⁻¹
 - Large lakes: 0.5 - 1 m d⁻¹
- Thus, if CO₂ is being generated at the same volumetric rate, the reduction in exchange velocity should result in a proportional increase in departure from equilibrium
- $(2200-380)/(660-380)=6.5$

Change in depth

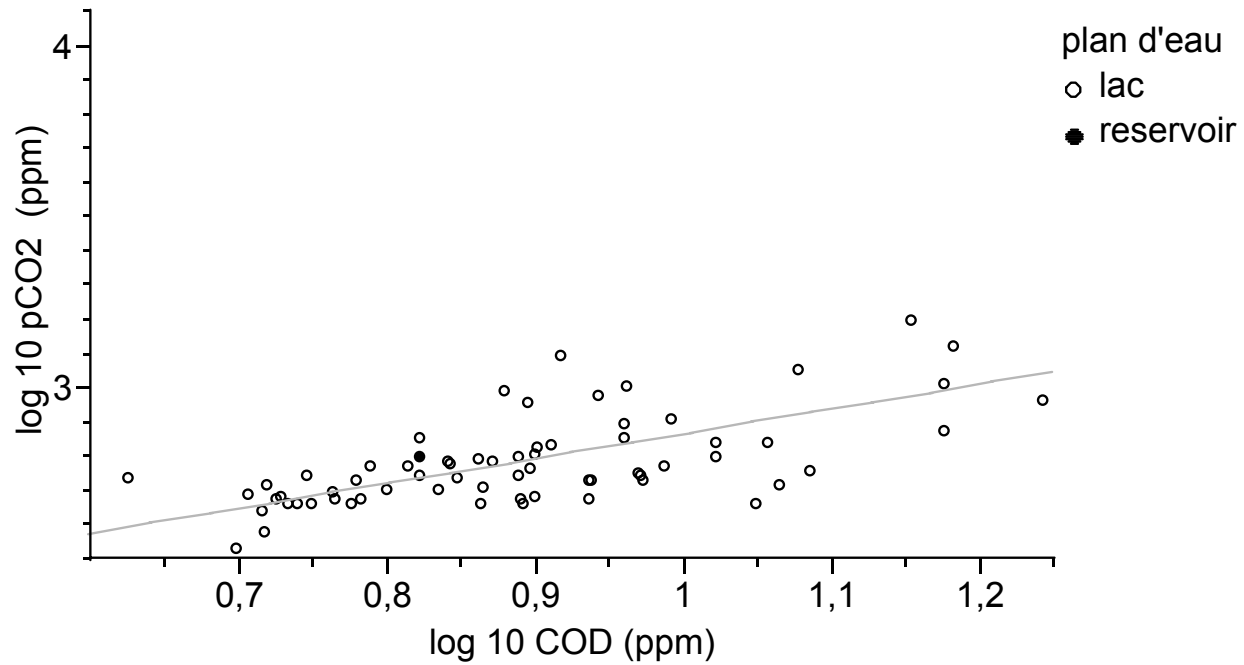
- Again change in depth should result in proportional change in $p\text{CO}_2$ departure from equilibrium

Is it metabolic?

QuickTime™ and a
None decompressor
are needed to see this picture.

More CO₂ produced than O₂
consumed

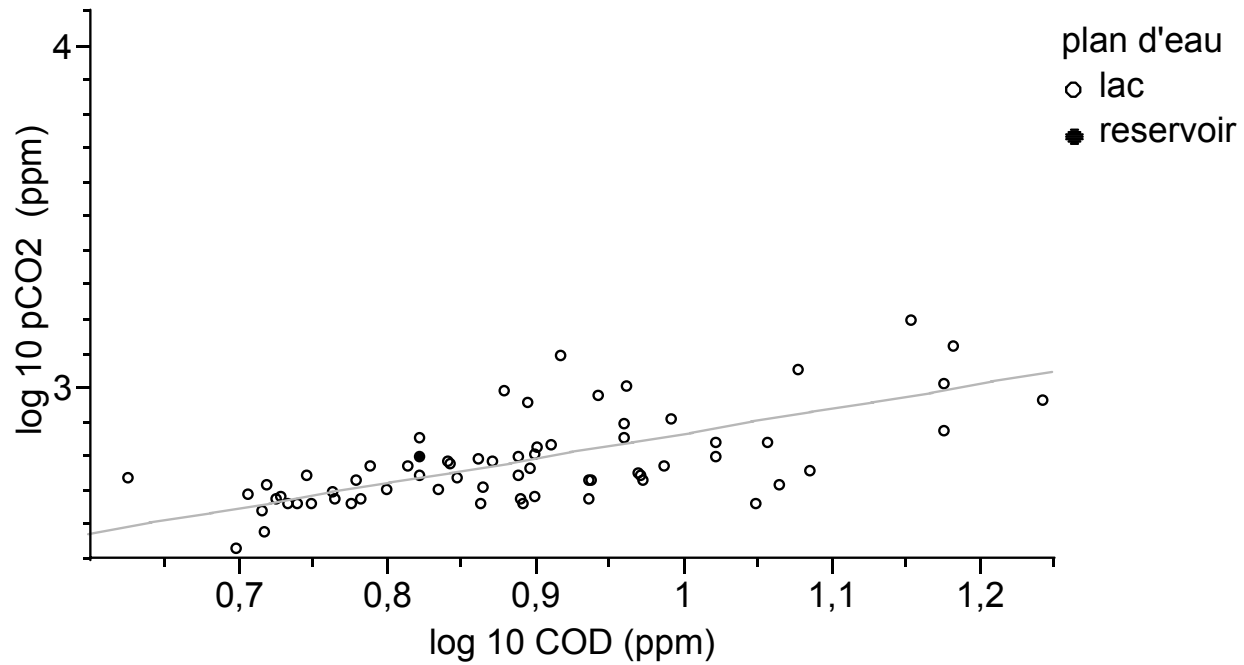
QuickTime™ and a
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$$\log[CO_2] = 2.34 + 0.48 \log[DOC] - 0.11 \log[LA] \quad r^2=0.72; p<0.0001$$

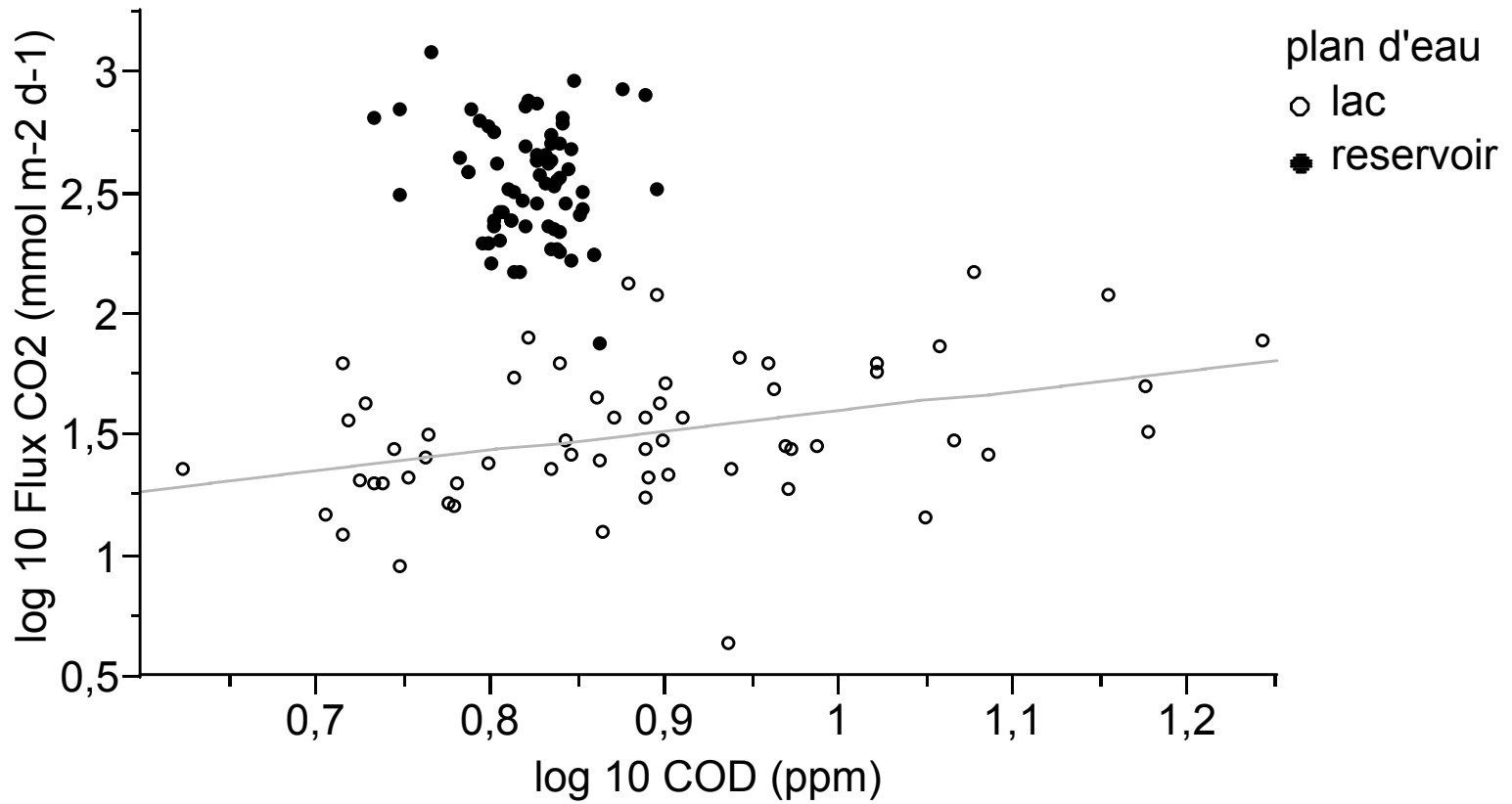
Are boreal and temperate lakes similar?

QuickTime™ and a
None decompressor
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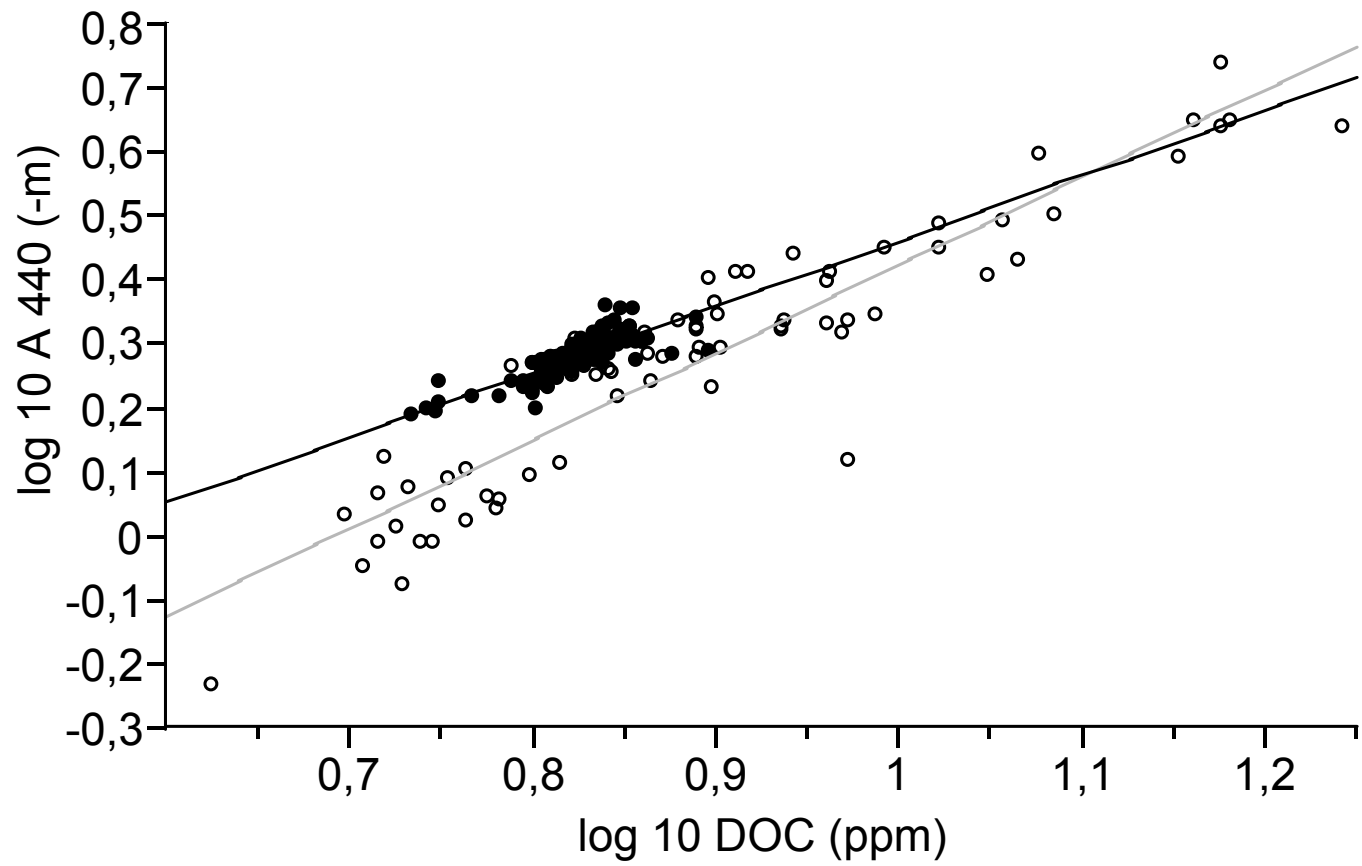


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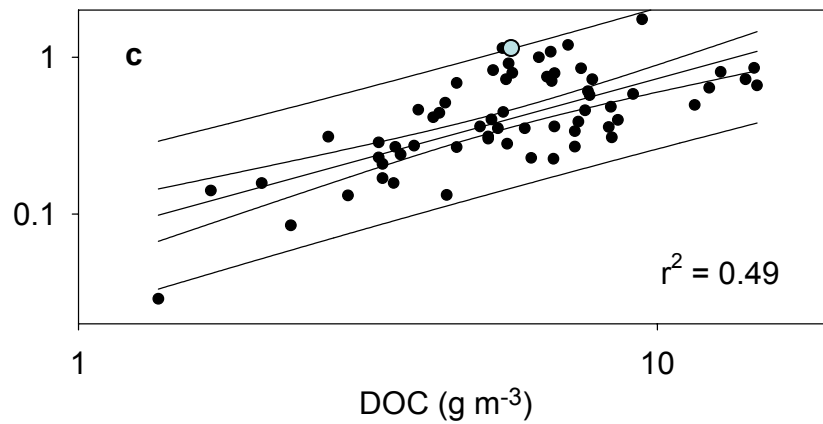
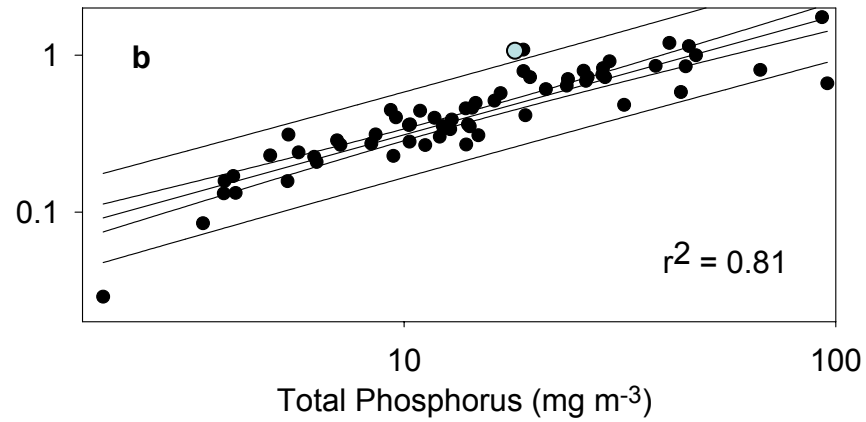
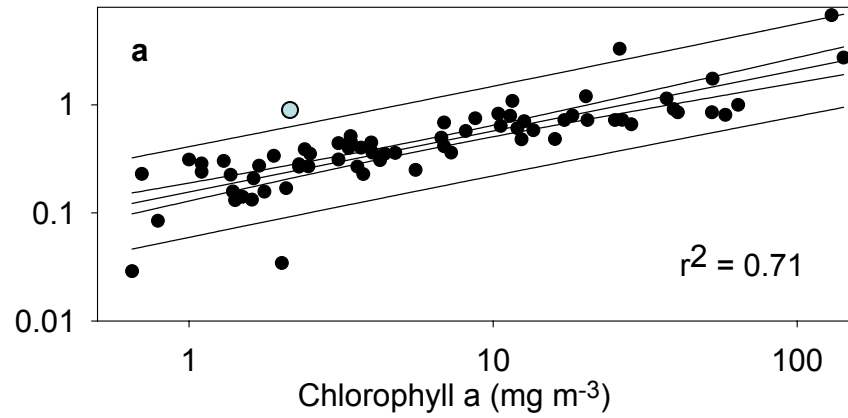
CO2 flux



Is it DOC quality?

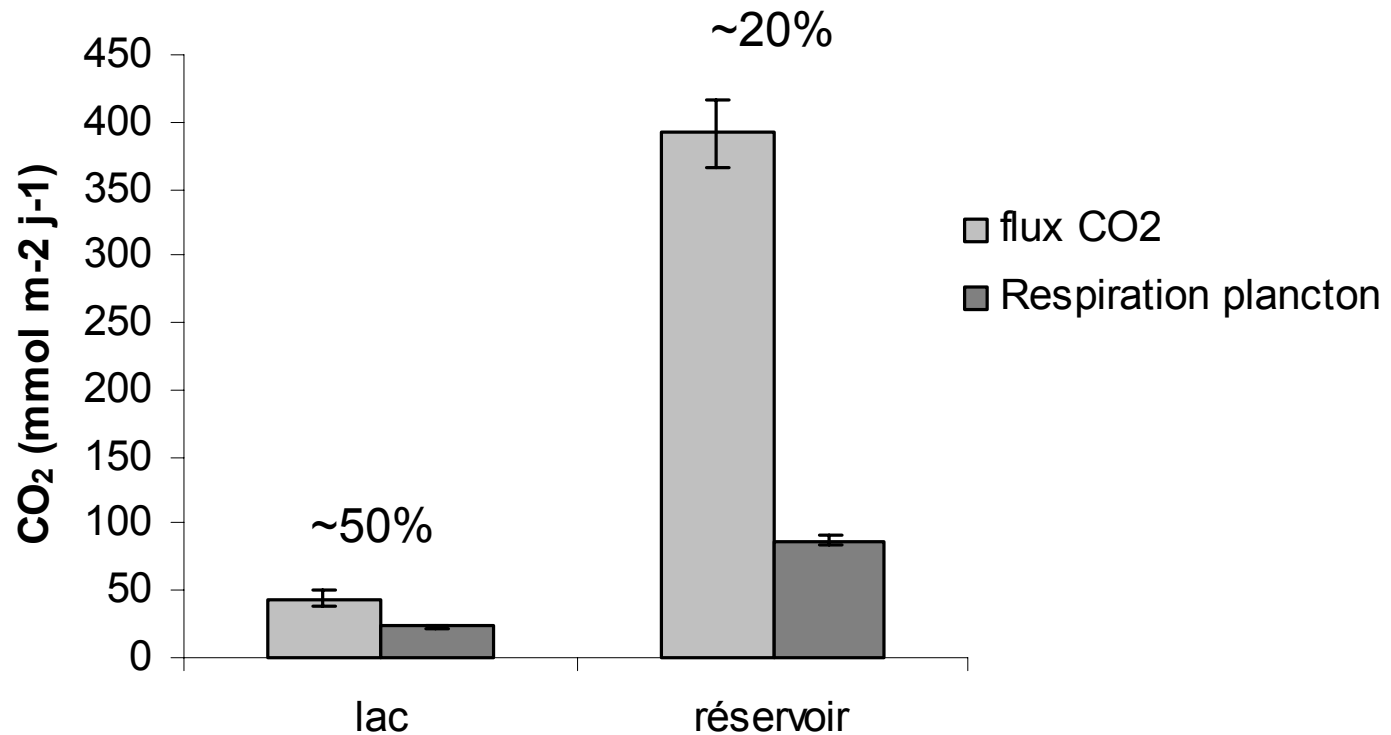


Planktonic respiration
(mmol O₂ m⁻³ h⁻¹)



Pace and Prairie 2005

CO₂ flux and planktonic respiration

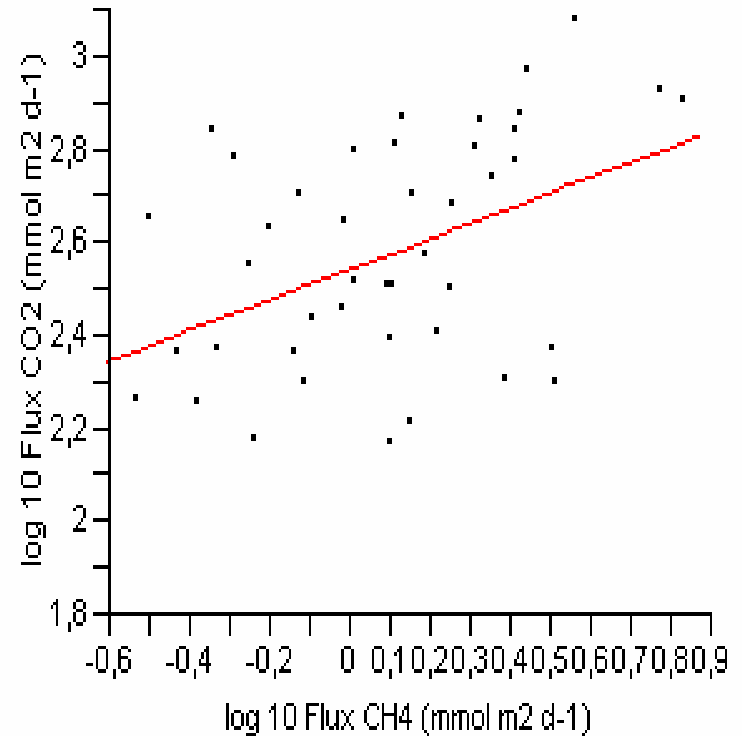
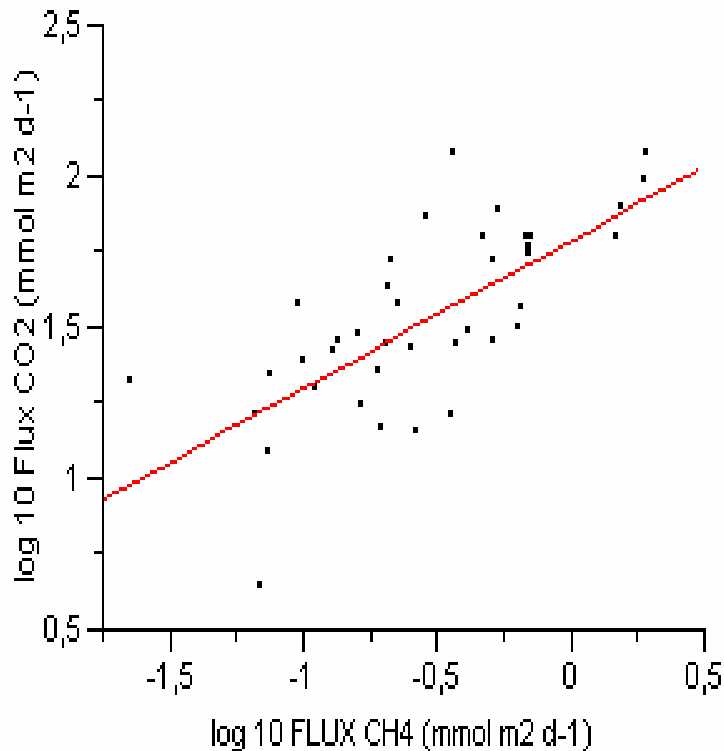


A brief look at methane

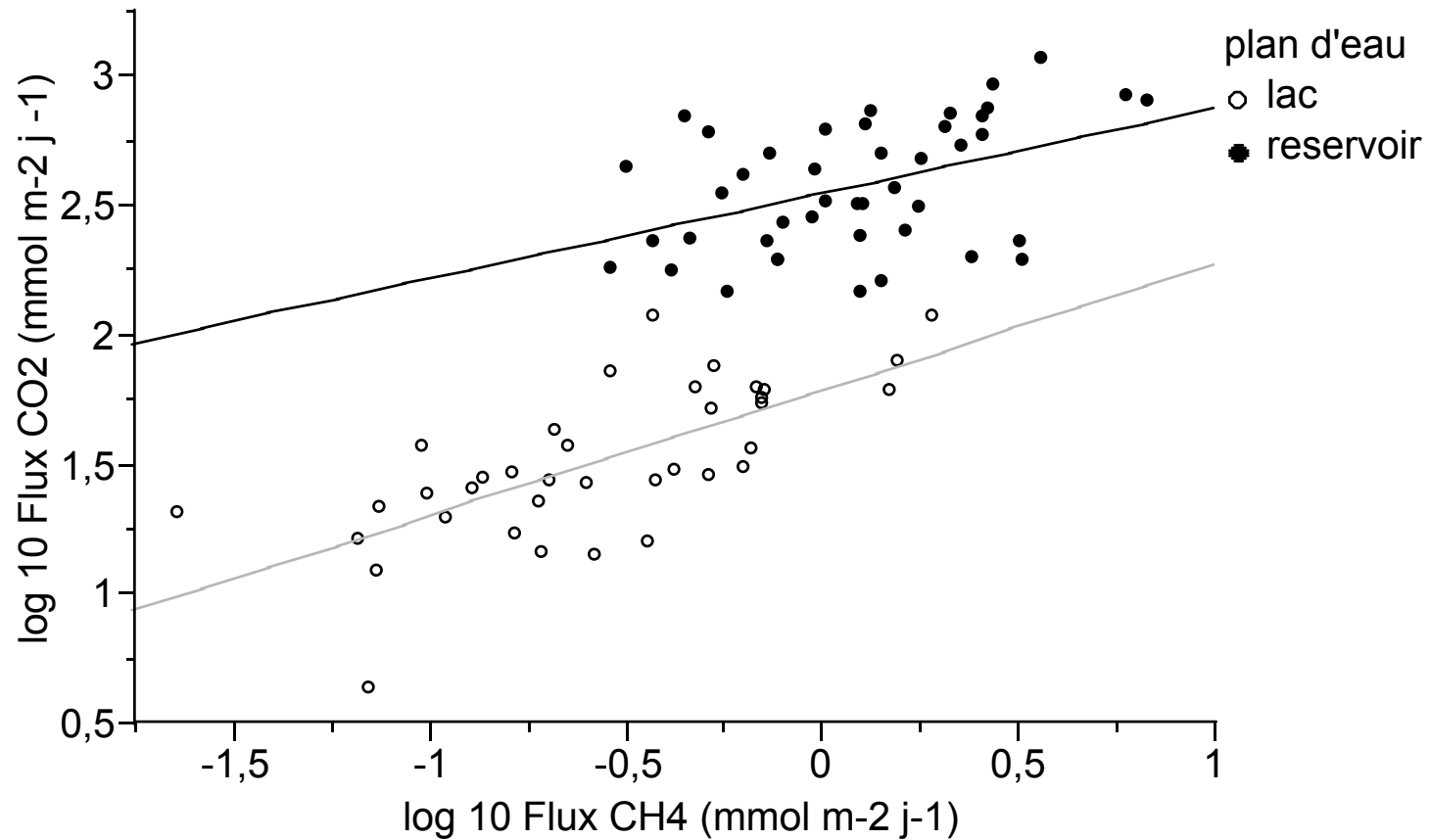
Methane and CO2 flux are closely linked

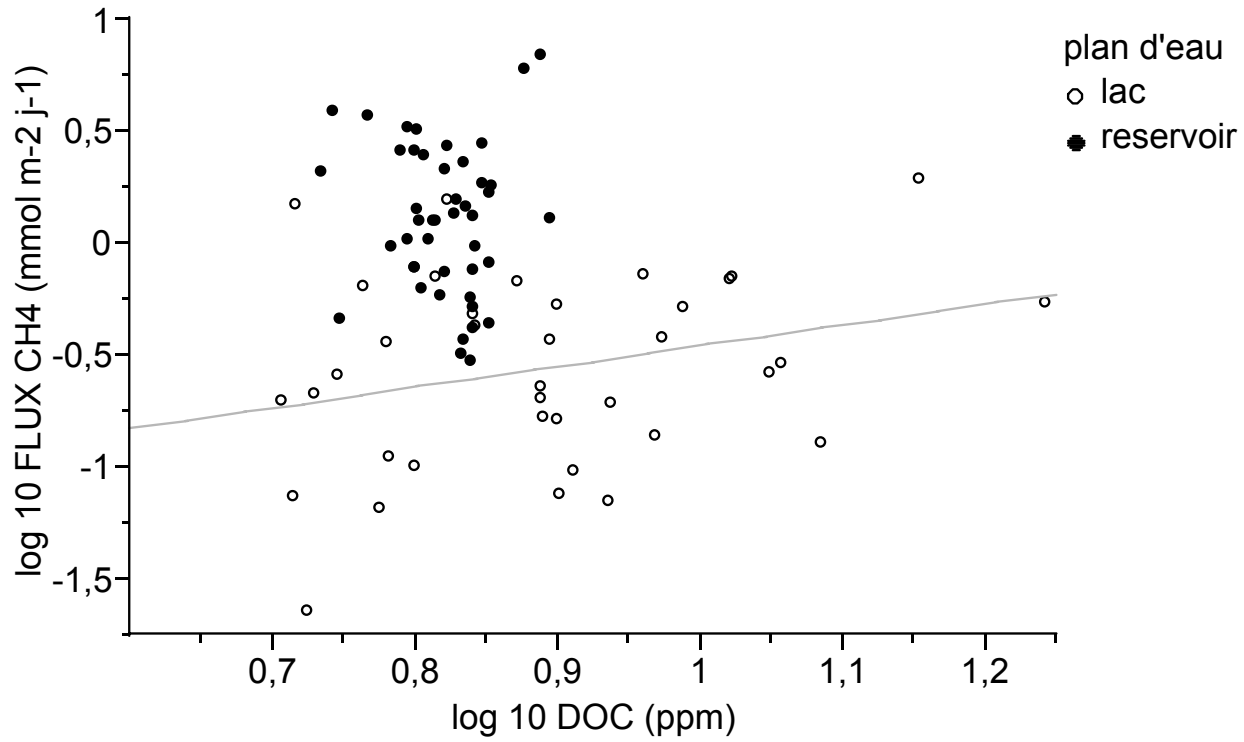
$$\log_{10} \text{ Flux CO}_2 = 1,7947206 + 0,4891717 \log_{10} \text{ FLUX CH}_4$$

$$\log_{10} \text{ Flux CO}_2 = 2,5446417 + 0,3300905 \log_{10} \text{ FLUX CH}_4$$



Different in reservoirs...





Some conclusions

- Carbon cycling and net CO₂ emissions are similar in boreal and temperate ecosystems.
- In the 1st year of reservoir flooding, this dynamic is significantly altered
- This change is largely due to change in benthic metabolism.