

Introduction Boreal ecosystems contain one of the highest freshwater densities in the world. Supersaturated in CO₂ with respect to atmospheric equilibrium, C emission from boreal surface waters is likely to play a significant role in C cycling, yet the contribution to regional and global C balances remains unclear.



Questions 1) What is the magnitude and variability of C emissions from the boreal aquatic ecosystem network?; and 2) How do aquatic emissions compare with other components of the C budget?

Methodology

- Use the established semi-empirical relationships between pCO₂ and physical proprieties of water bodies;
- Scale up to the entire landscape using this relationship and the distribution of the predictor variables.

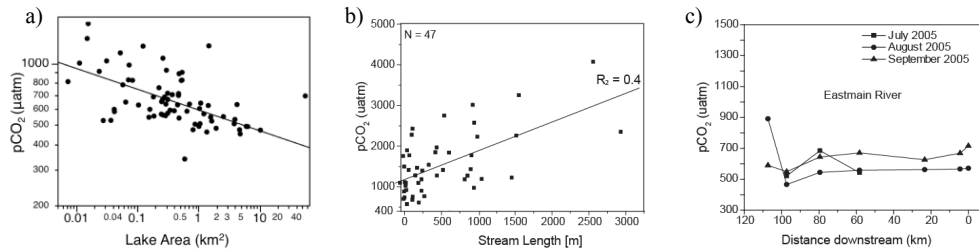


Figure 1. Established relationships between pCO₂ and a) lake area (Roehm et al., 2009); b) stream length (Teodoru et al., 2009); and c) river distance (Teodoru et al., 2009).

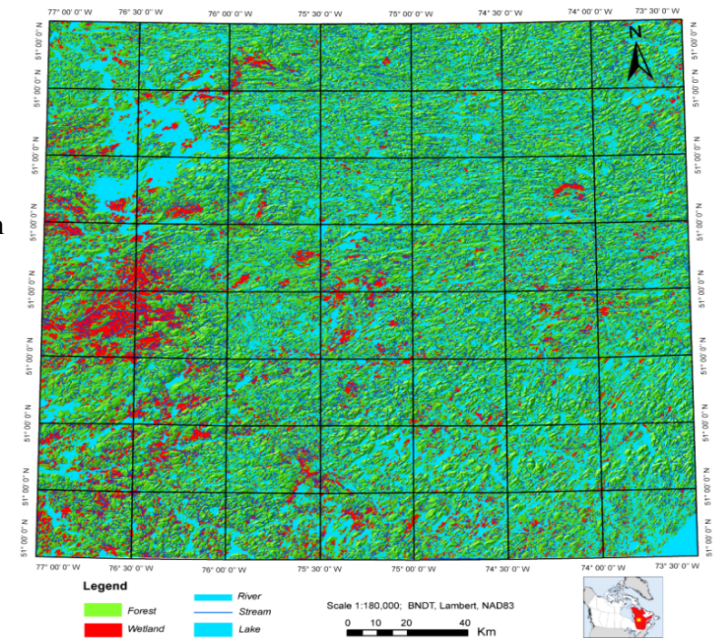


Figure 2. Hydrological network across a 50,000 km² patch of boreal landscape (northern Quebec, Canada).

Results C fluxes are not only regionally significant relative to other better known aspects of the boreal C balance, but also remarkably constant: aquatic CO₂ flux per unit landscape varied less than two-fold across this boreal landscape, despite a 10-fold range in aquatic coverage (Figure 3a, b, c).

Conclusions

- Our results suggest a complex interplay between *geomorphologic features* (altitude, slope), which determine the type, size, and distribution of aquatic components in the landscape, and *biogeochemical processes*, which determine the intensity of C fluxes across various aquatic ecosystems.
- These total aquatic emissions, for which we propose the name of *Net Biome Aquatic Carbon Evasion* (NBACE), thus represent an emergent property of the boreal biome next to GPP (600÷800 g C m⁻² yr⁻¹), NEE (-15÷30 g C m⁻² yr⁻¹), SR (250÷350 g C m⁻² yr⁻¹), Net Soil Carbon Accumulation (1÷2 g C m⁻² yr⁻¹).

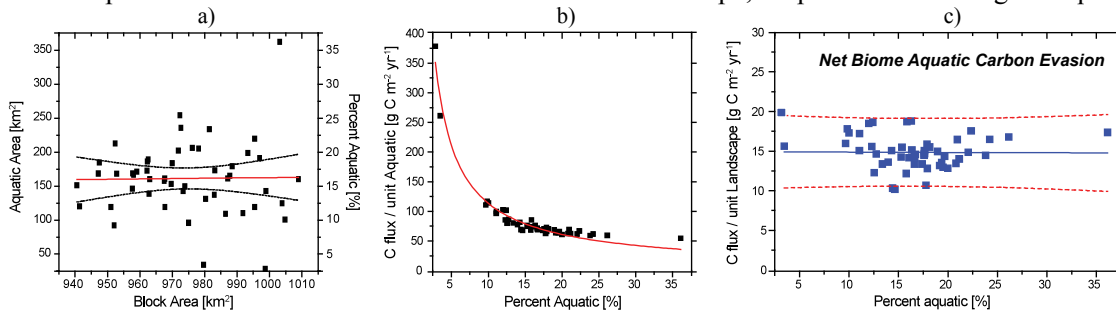


Figure 3. Distribution of total aquatic ecosystem in the landscape (a); CO₂ flux per unit aquatic area (b); and aquatic CO₂ flux per unit landscape (c).