Hydrological budget in aqualized peatlands of the James Bay Region (Canada)

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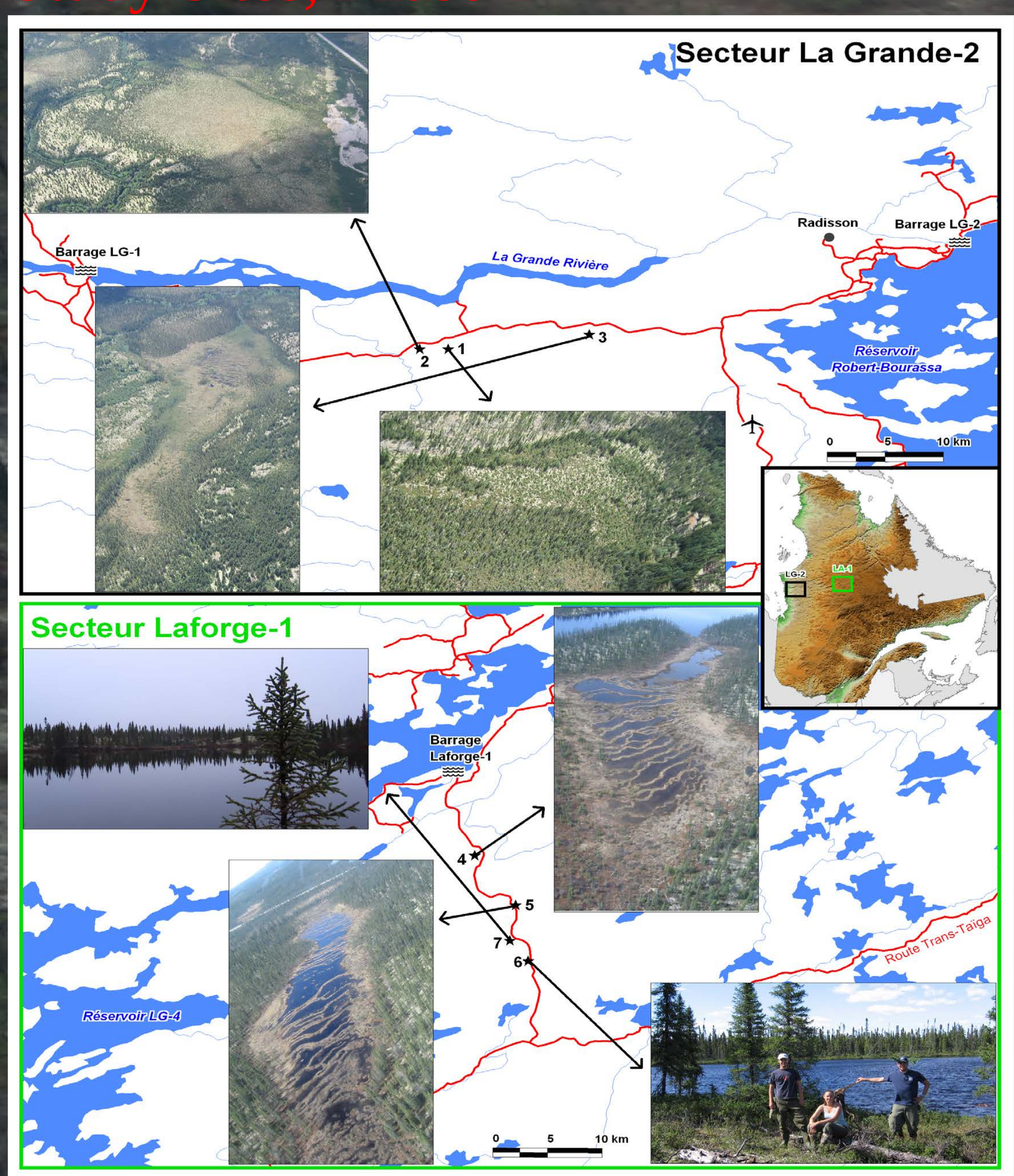
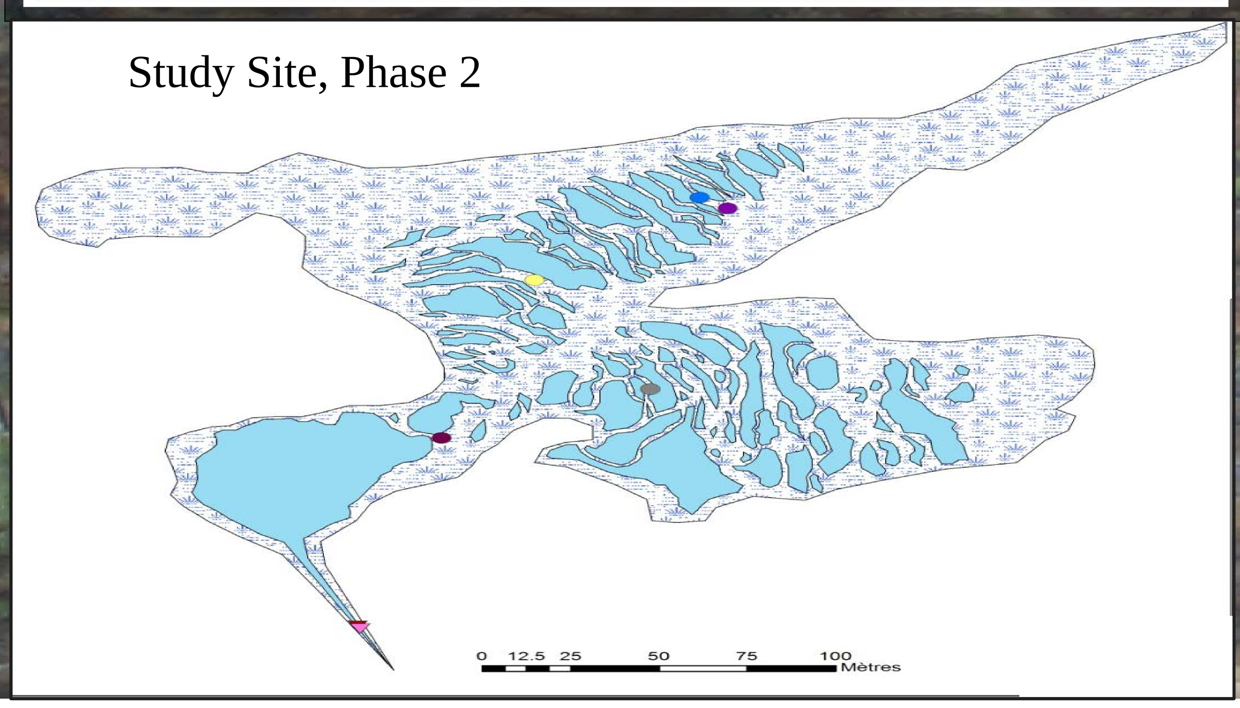
Context and objectives:

This poster summarizes the work completed on a number of peatlands of the La Grande River Watershed, in the James Bay region of Québec, Canada. The objective of the study was to describe the impact of aqualysis (a phenomenon by which the water coverage of peatlands is seen to increase over time). The first component of the study was a comparison of hydrological budgets performed on for two *Sphagnum* bogs, three patterned fens and two shallow lakes, which represent a gradient of aqualysis from relatively low surface water coverage (bogs) to complete water coverage (shallow lakes). The second part describes a follow-up study completed in 2009, focusing on one highly aqualized fen in the same area. Again, the study included the monitoring of key hydrological inputs and outputs in order to compute a hydrological budget and allowed for the comparison of different equations to calculate evapotranspiration.

Study Sites, Phase 1



Study Site, Phase 2



Methodology:

Hydrograph shape statistics were used to compare the rainfall-runoff relationship along the aqualysis gradient. Shape mean (Sm), Shape Variance (SV), hydrograph slopes.

$$S_m = \frac{1}{A}\sum_{i=1}^{n} t_i A_i \qquad S_v = \sum_{i=1}^{n}\left(t_i - S_m\right)^2 \times A$$

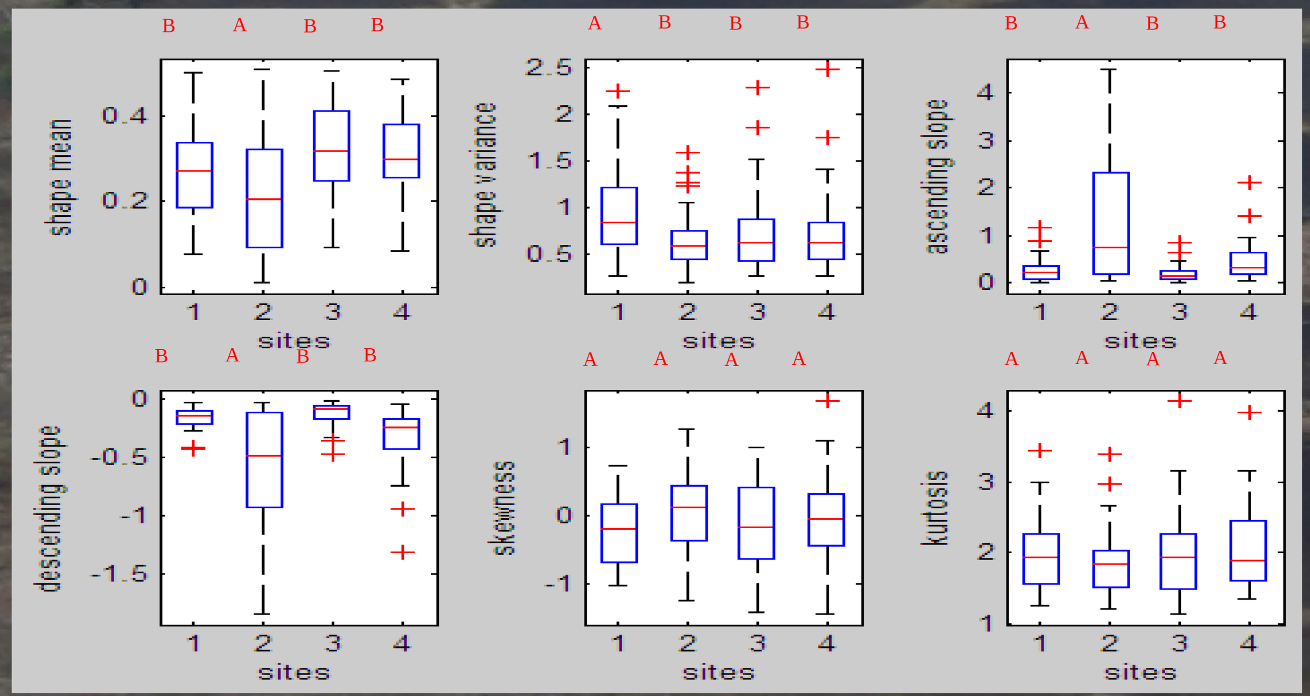
Where n is the length of the event (in days), t_i is the horizontal distance or duration (in days) from the starting point of the hydrograph, A_i is the surface of the sub-area between t_i and t_{i-1} and A is the total area under the curve of the hydrograph (the sum of A_i in mm). All of the statistics described above were calculated for each event.

Hydrological Budget Calculations:

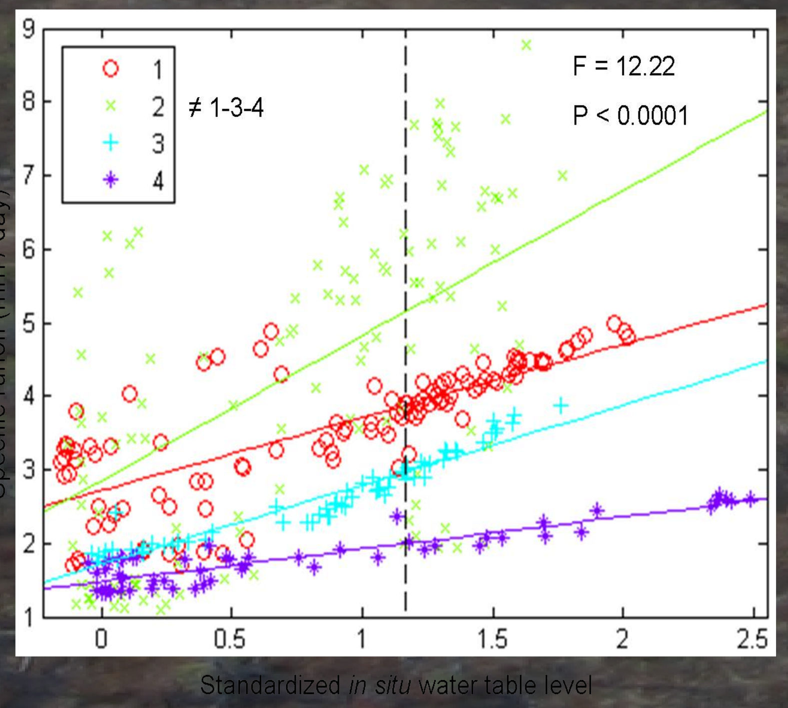
$$P - ETP - Q = \Delta s/\Delta t$$

In this equation, liquid et solid precipitation (P), Surface runoff (Q), variation of groundwater levels (ΔS) and evapotranspiration (ETP) are considered.

Results Phase 1:



Box plots of hydrograph shape metrics along the aqualysis gradient

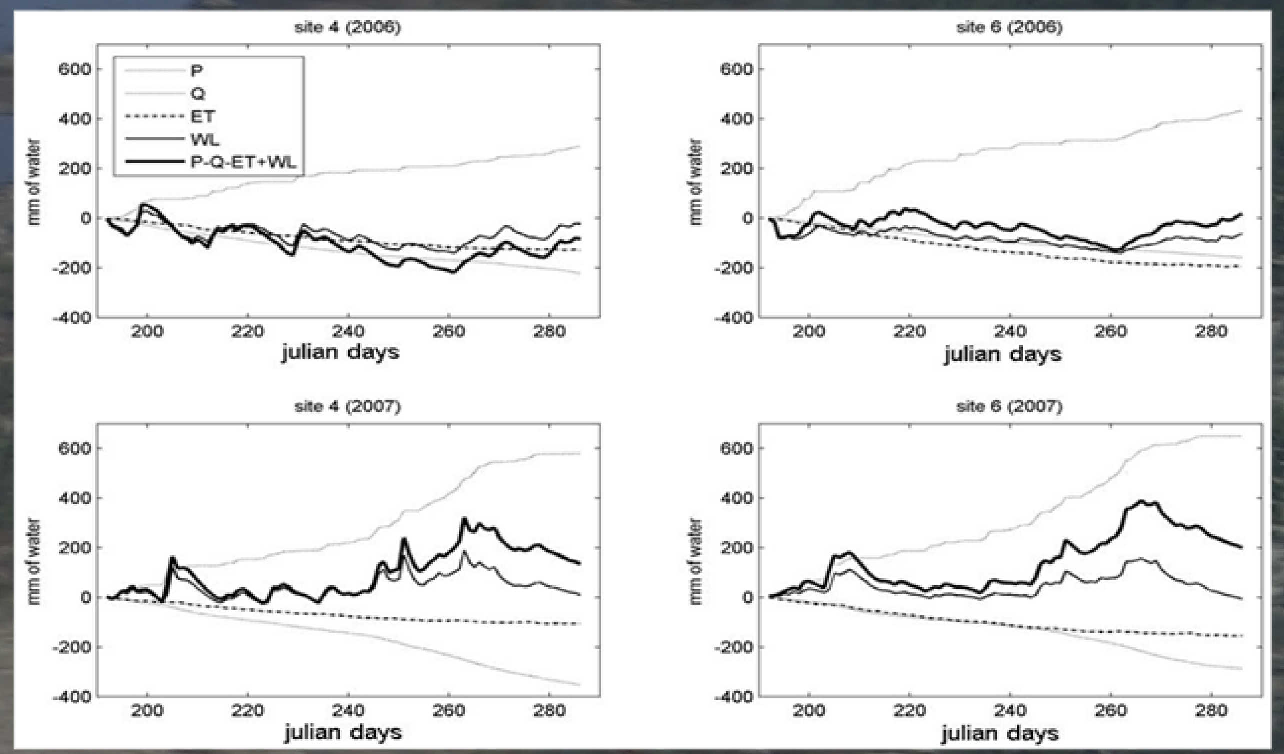


ANCOVA comparing regression slopes Between water-table levels and runoff along the aqualysis gradient

	2005		2006		2007	
	Site 4	Site 6	Site 4	Site 6	Site 4	Site 6
P (mm)	471.6	558.7	290.2	433.0	580.8	649.0
Q (mm)	-297.7	-208.0	-221.6	-158.7	-351.2	-287.1
PET (mm)	-137.9	-207.3	-128.5	-194.7	-106.1	-154.8
ΔWL (mm)	-62.4	-65.1	22.4	62.8	-11.1	6.3
η (mm)	98.4 (21%)	208.5 (37%)	-82.4 (28%)	17.6 (4%)	134.7 (23%)	200.7 (31%)

Comparison of seasonal hydrologic budget Terms between a highly aqualyzed fen and A shallow lake.

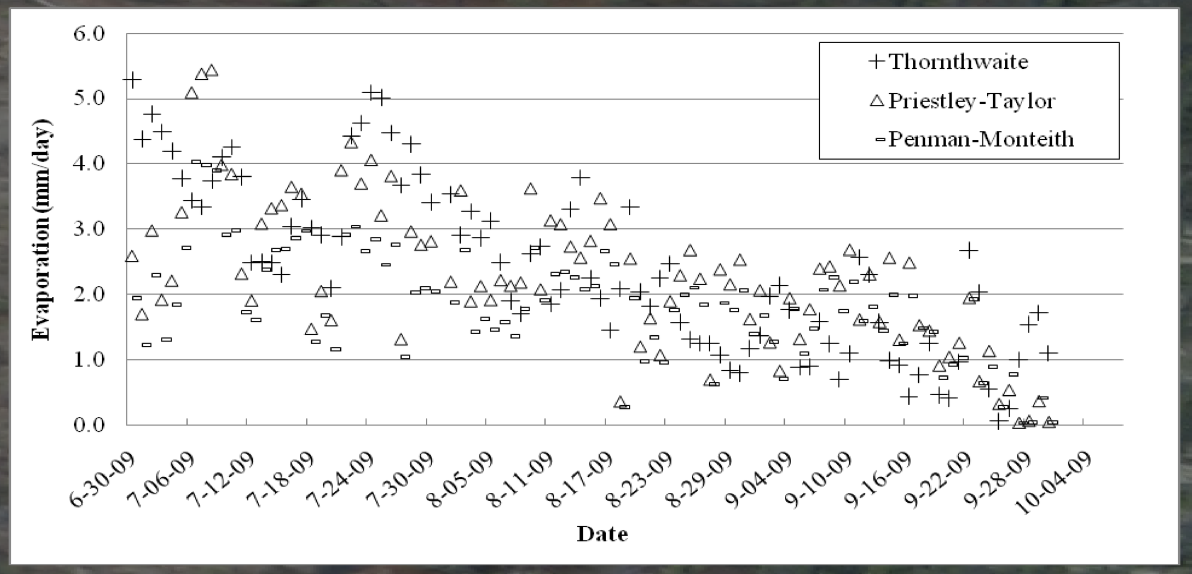
Temporal evolution of hydrologic budget terms (highly aqualyzed fen, site 4 vs. shallow lake, site 6)



Results from Phase 2:

Season	P	Q	PET	ΔWL	η	Δs
With Thornthwaite-Priestley-Taylor PET	263.0	95.4	207.0	97.2	57.8	-39.4
With Penman-Monteith PET	263.0	95.4	162.2	97.2	102.6	5.4
July						
With Thornthwaite-Priestley-Taylor PET	45.5	6.5	102.8	-0.8	-64.6	-63.8
With Penman-Monteith PET	45.5	6.5	72.1	-0.8	-33.9	-33.1
August						
With Thornthwaite-Priestley-Taylor PET	183.4	78.1	68.8	29.5	66.0	36.5
With Penman-Monteith PET	183.4	78.1	55.6	29.5	79.2	49.7
September						
With Thornthwaite-Priestley-Taylor PET	34.1	10.8	35.4	68.4	56.2	-12.1
With Penman-Monteith PET	34.1	10.8	34.5	68.4	57.1	-11.2

Comparison of seasonal hydrologic budget Terms in a highly aqualyzed fen.



ETP Estimates using three different equations

Conclusions :

- Four of the six hydrographs shape statistics (shape mean and variance, rising and falling slopes) were found to be significantly different between some sites, lakes (contrary to fens) being always in the same category. These results also indicate that the location of individual ponds on fens may play a role in runoff generation.
- Concerning the relation between water table level and outlet runoff, regression slopes of fens were found to be steeper than those of lakes, especially in wet conditions.
- The estimation of peat matrix water storage is potentially the largest source of error and the limiting factor to calculate water balances in this environment. The results show that the groundwater level and the water storage vary depending on the season and especially after a heavy rainfall.
- Thorntwaite and Priestley-Taylor equations overestimate PET when compared to Penmann-Monteith in an aqualyzed peatland.

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