

The Impact of Open-Water Pools on the Net Ecosystem CO₂ Exchange of a Boreal Peatland

Luc Pelletier, Ian Strachan, Nigel Roulet,
Michelle Garneau, Karoline Wischnewski

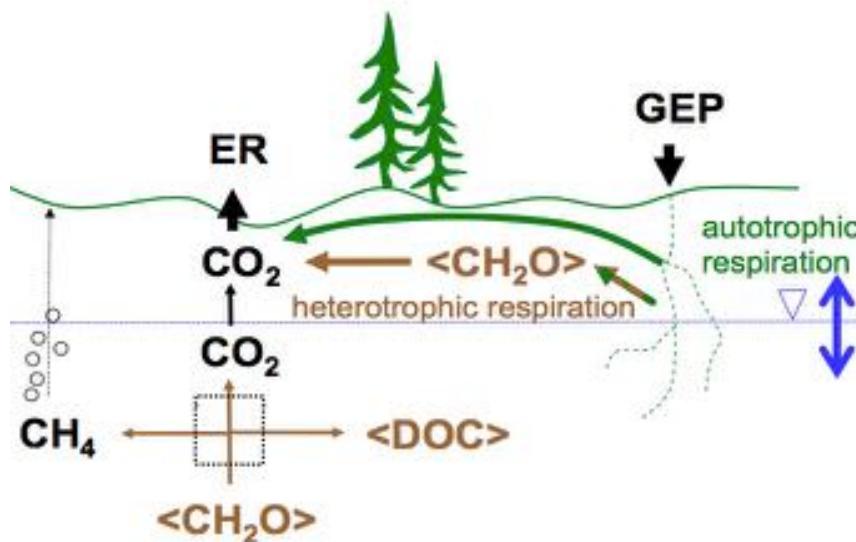
2015 Joint Assembly, May 5 2015



Acknowledgements

- Dr. Onil Bergeron, Dr. Mike Billet, Dr. Kerry Dinsmore, Dr. Jean-Francois Hélie, Dr Tim R. Moore, Dr. Oliver Sonnentag, Dr. Julie Talbot, Dr. Alain Tremblay
- Hans Asnong, Marie-Claude Bonneville, Rui Cheng, Eric Christensen, Stephanie Crombie, Mike Dalva, Frank Ferber, Jean-Louis Fréchette, Silvie Harder, Manuel Helbig, Mathilde Jammet, Annie Lamalice, Camille Lefrancois, Valérie Lefrancois, , Avni Malhotra, Julien Minville, Kelly Nugent, Julien Robitaille, Holly Stewart, Antoine Thibault, Meng Wang, Caitlin Watt, and Tanja Zivkovic.
- NSERC (CRD - Dr. Michelle Garneau, DG - Dr. Ian B. Strachan, Postgraduate Scholarships-Doctoral – Luc Pelletier), McConnell Foundation, McGill Graduate Excellence program and GREAT travel grants from McGill Department of Natural Resource Sciences.

Peatlands and C

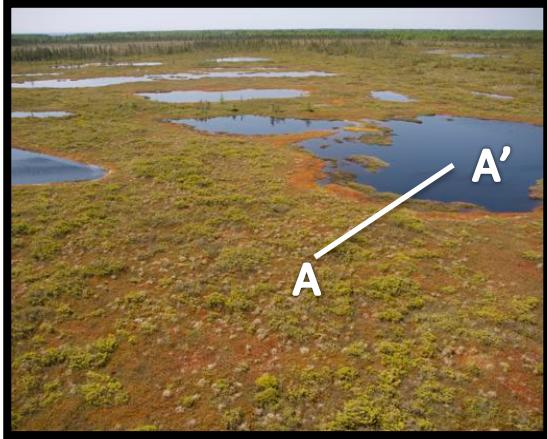


Modified from Limpens et al., 2008 - *Biogeosciences*

Net Ecosystem Carbon Balance (NECB): -22 to $-70 \text{ g C m}^{-2} \text{ yr}^{-1}$

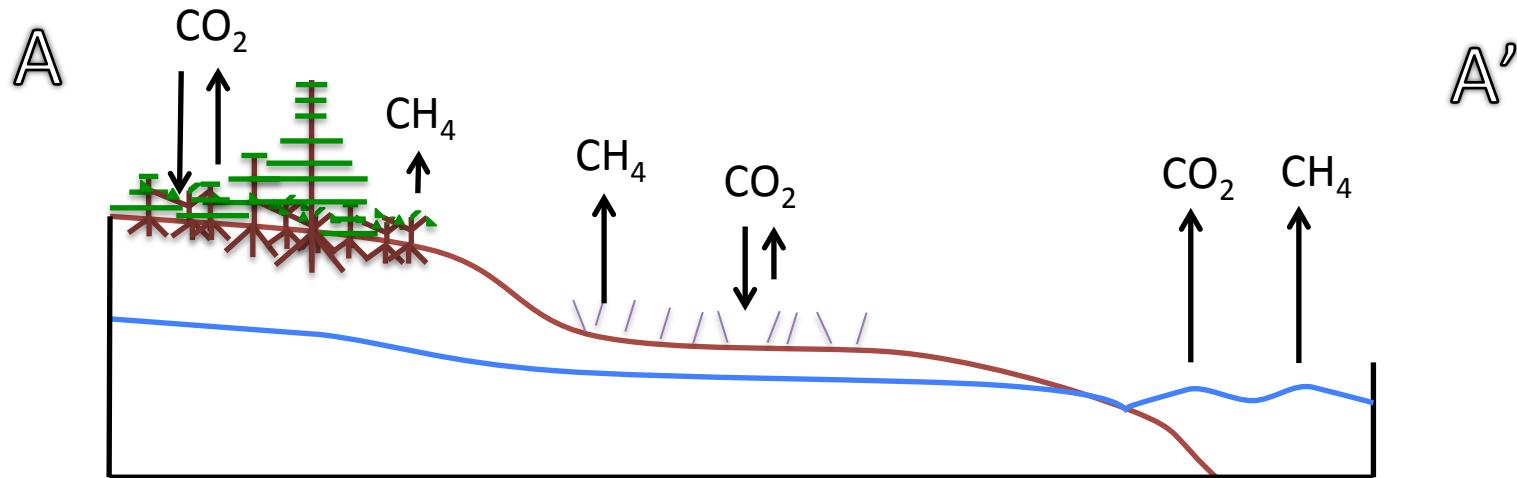
(Roulet et al., 2007 - *GCB*; Nilsson et al., 2008 - *GCB*; Dinsmore et al., 2010 - *GCB*; Koehler et al., 2011 - *GCB*; Olefeldt et al., 2012 - *GRL*)

Peatland pools and C fluxes



Annual C release from pools: **23 to 419 g C m⁻² yr⁻¹**
(Waddington and Roulet, 2000; Repo et al., 2007; McEnroe et al., 2009,
Trudeau et al., 2014, Pelletier et al., 2014)

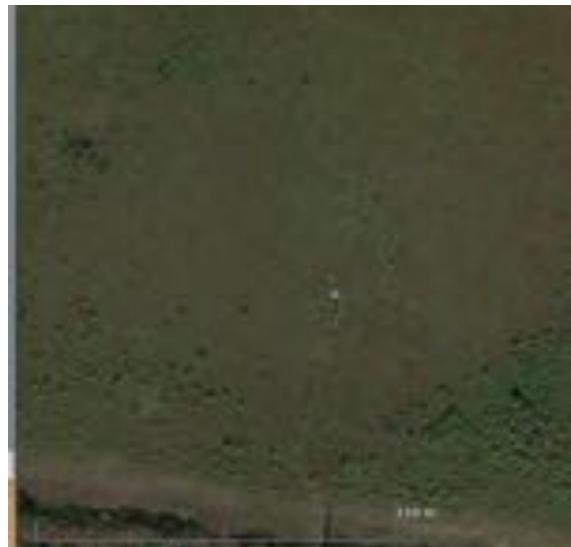
NECB: **-22 to -70 g C m⁻² yr⁻¹** (Roulet et al., 2007 - *GCB*; Nilsson et
al., 2008 - *GCB*; Dinsmore et al., 2010 - *GCB*; Koehler et al., 2011 - *GCB*;
Olefeldt et al., 2012 - *GRL*)



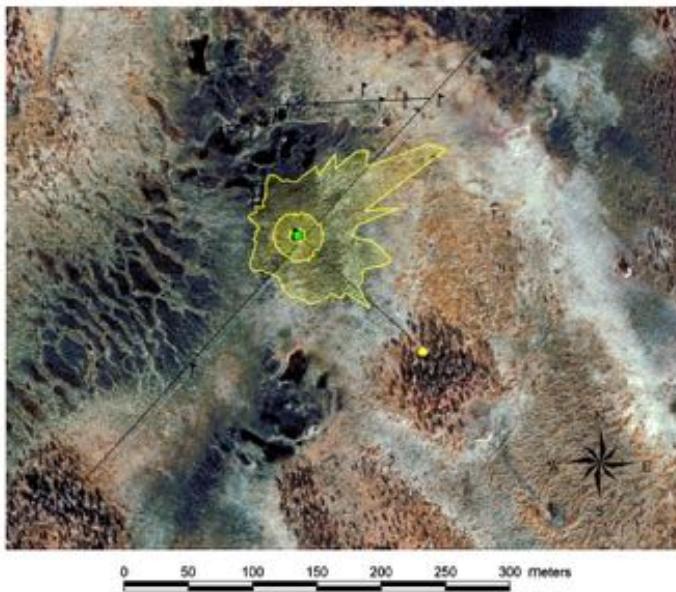
Peatlands and pools



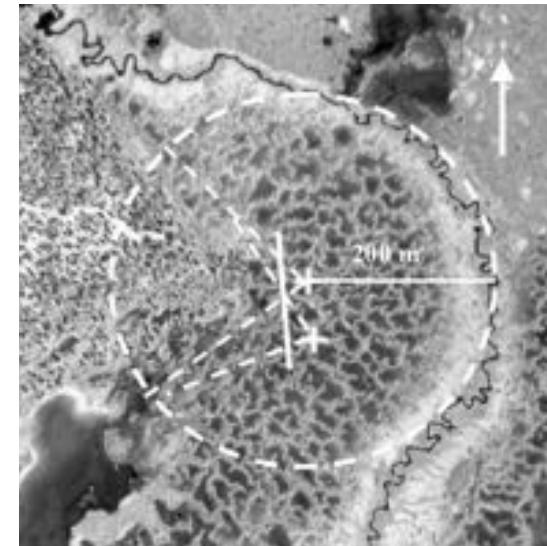
Net ecosystem CO₂ exchange in peatlands



Mer Bleue bog, Canada
Roulet et al. (2008 – *GCB*)



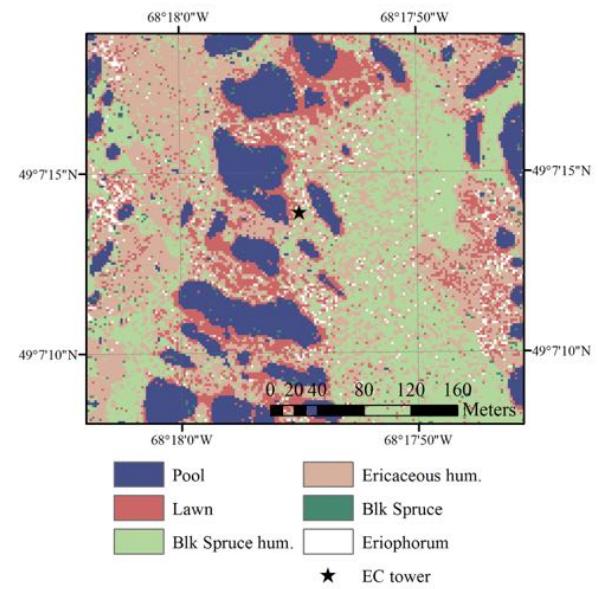
Degerö Stormyr, Sweden
Sagerfors et al. (2008 – *JGR Biogeosciences*)



Kaamanen fen, Finland
Heikkinen et al. (2002 – *Polar Research*)
Aurela et al. (2002 – *GRL*)

Research objectives

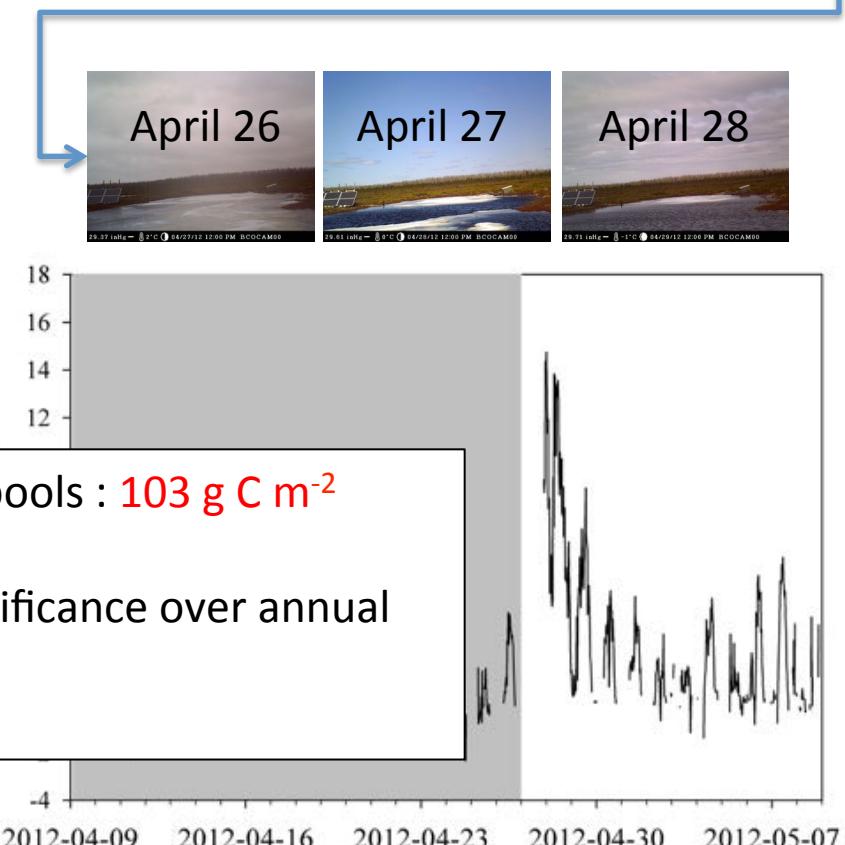
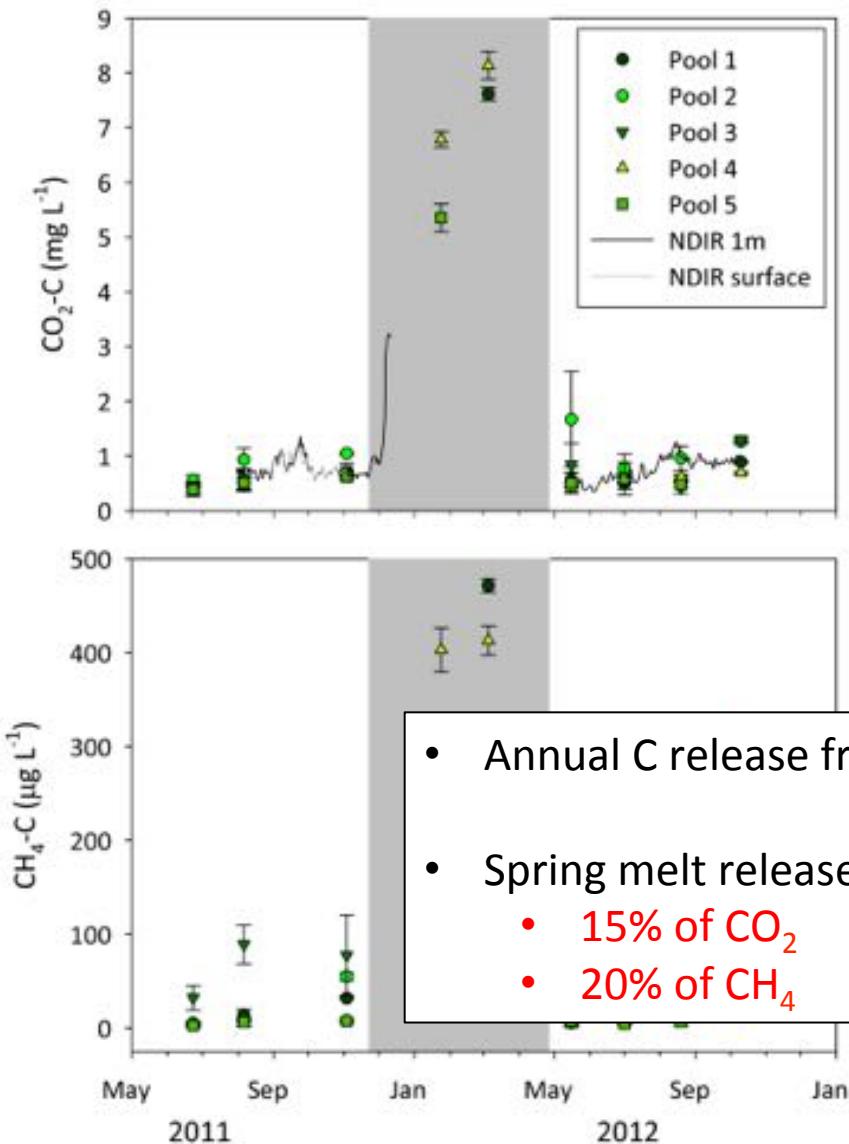
1. Assess the CO₂ sink capacity of a peatland with pools;
2. Identify the pool's CO₂ flux signal from the ecosystem level measurements.



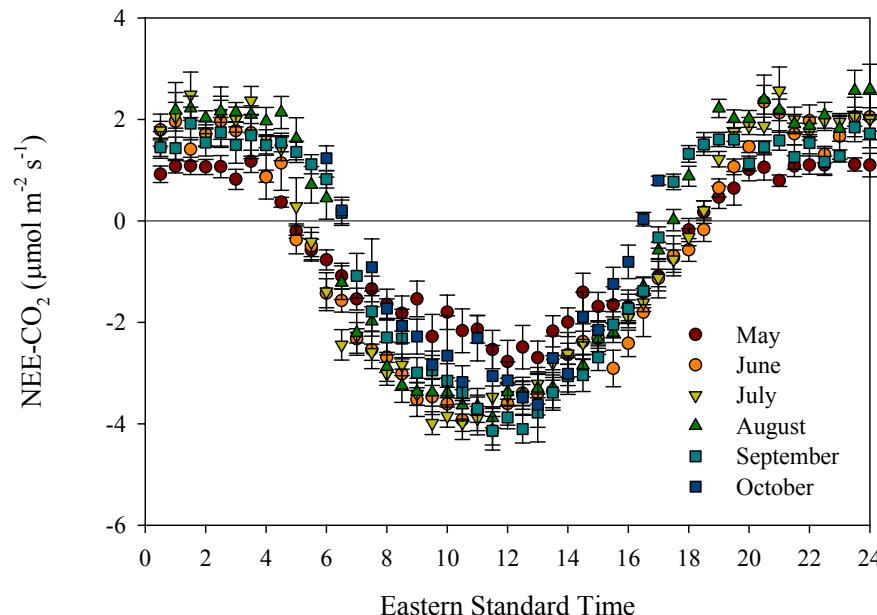
Dominant vegetation in the studied sector:

Chamaedaphne calyculata, Picea mariana, Kalmia angustifolia, Rubus Chamaemorus, Rhododendron groenlandicum, Sphagnum spp.

annual pool CO_2 and CH_4 loss to the atmosphere

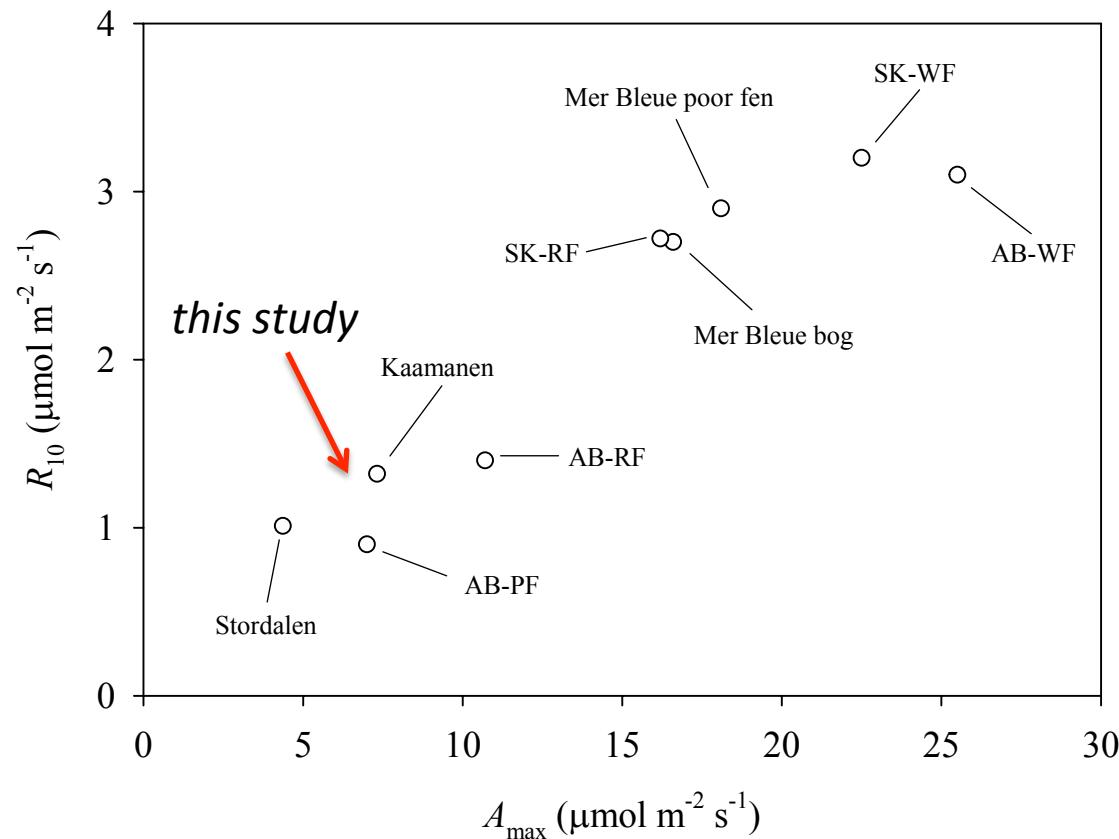


Objective #1: assess the CO_2 sink capacity of a peatland with pools



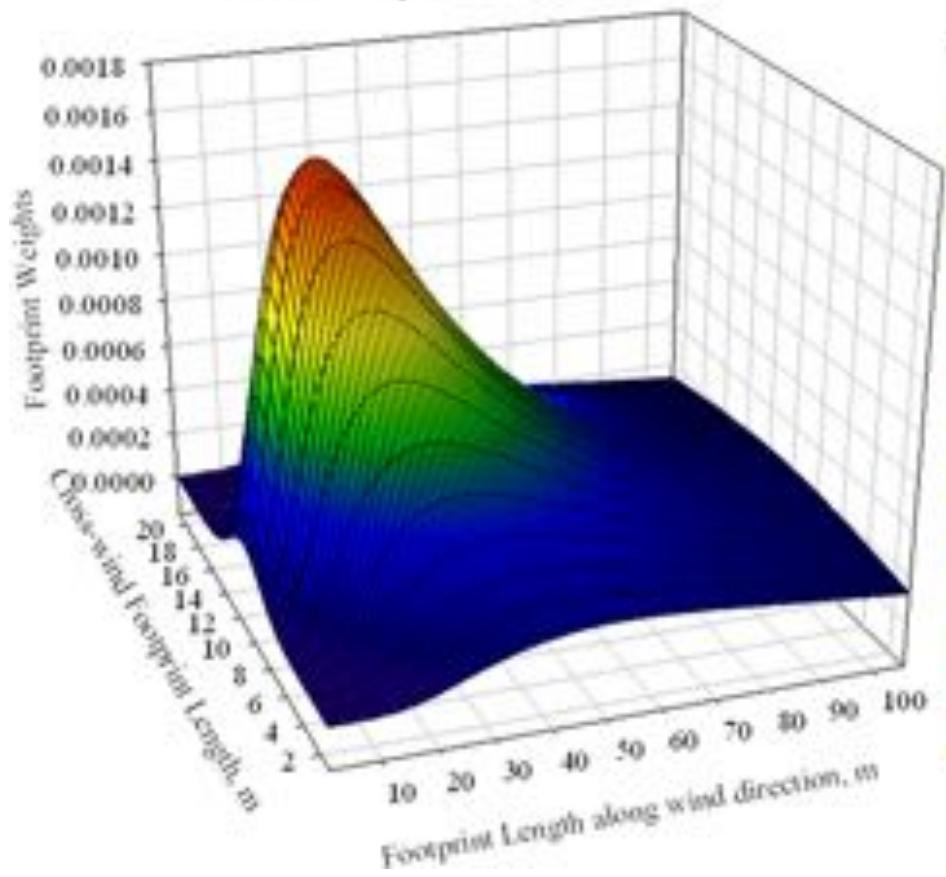
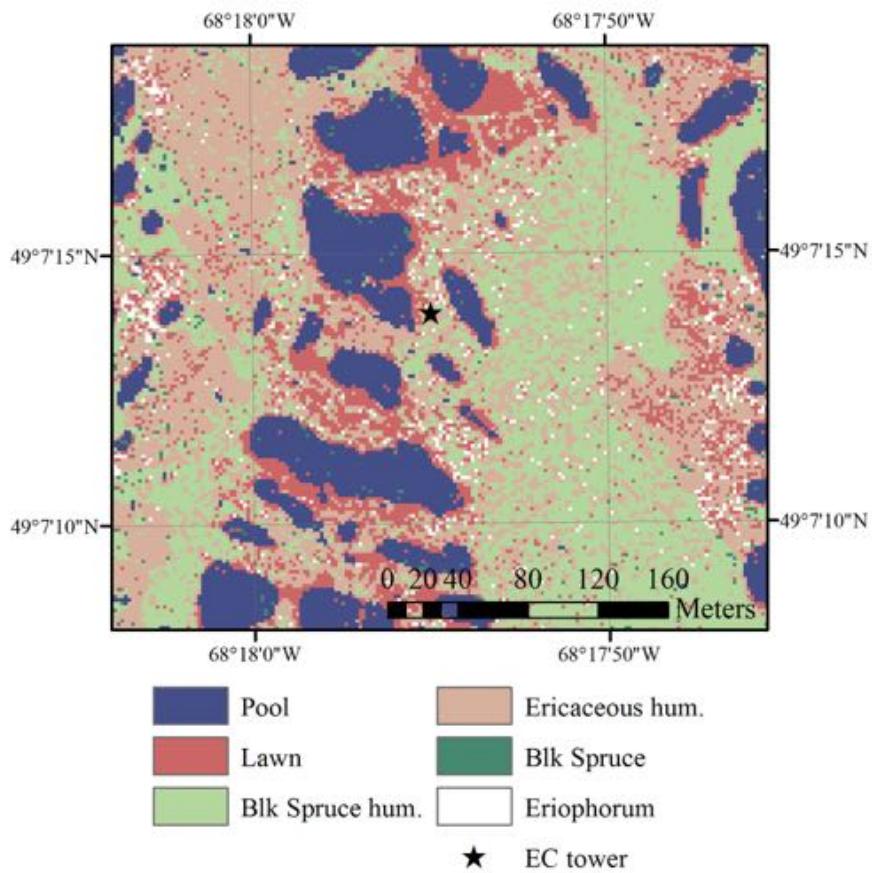
Peatland site	$\text{g CO}_2 \text{ m}^{-2} \text{ d}^{-1}$	Number of growing season	Source
Petite Rivière, Canada	-1.83	1	This study
Mer Bleue bog, Canada	-1.54 to -2.84	4	Lafleur <i>et al</i> 2003
Degerö Stormyr, Sweden	-2.05 to -2.59	3	Sagerfors <i>et al</i> 2008
Kaamanen, Finland	-1.51 to -3.86	3	Aurela <i>et al</i> 2001, 2002, Lindroth <i>et al</i> 2007
Lompolojärvikä, Finland	-4.11 to -5.20	3	Aurela <i>et al</i> 2009
Fäjemyr, Sweden	-1.88	1	Lund <i>et al</i> 2007
Sukaneva, Finland	-2.70	1	Lindroth <i>et al</i> 2007

Objective #1: assess the CO₂ sink capacity of a peatland with pools



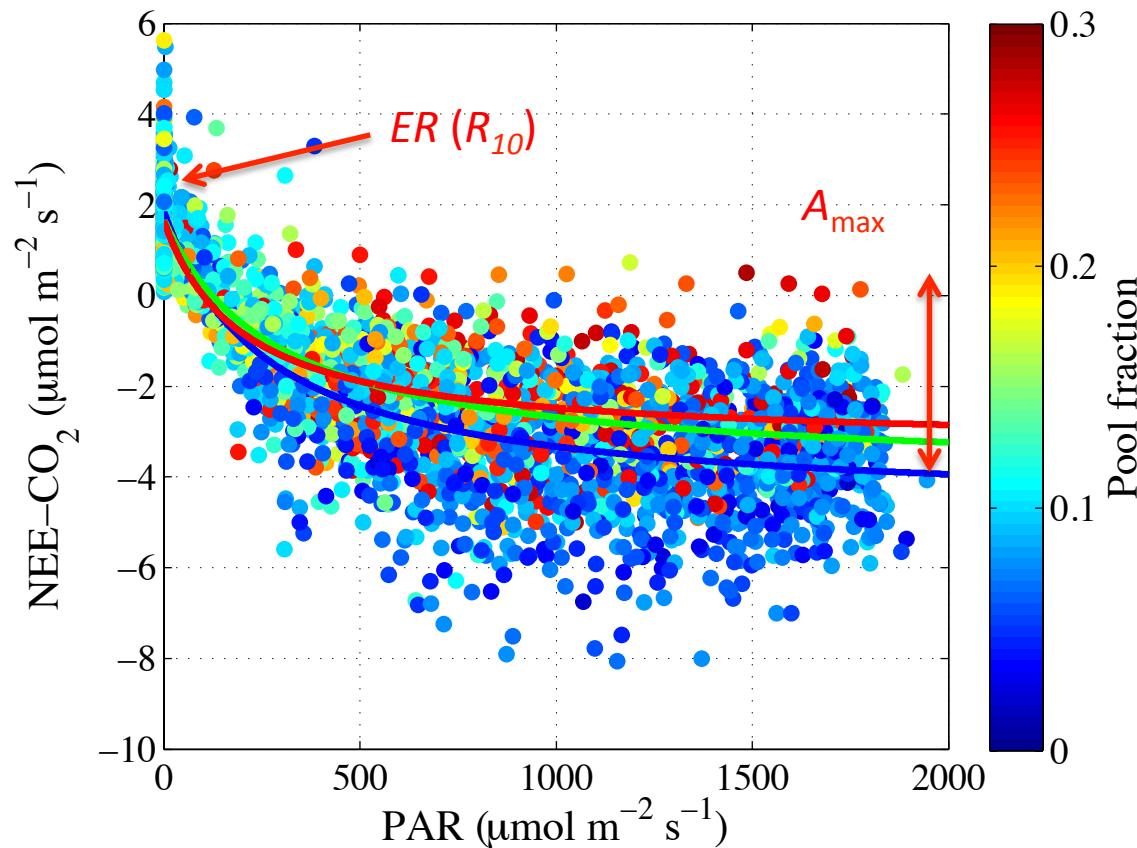
Sources: *Frolking et al., 1998; Humphreys et al., 2006; Lindroth et al., 2007; Sonnentag et al., 2010; Olefeldt et al., 2012; Silvie Harder – personal communication*

Objective #2: Identify pools CO₂ flux from ecosystem level measurements



Modified from Chávez *et al.*, (2009 – Irrigation Science)

Objective #2: Identify pools CO_2 flux from ecosystem level measurements



	Fraction	A_{\max}	α	R_{10}	r^2	n
Pools	<10%	-7.4a (-7.7, -7.1)	-0.020a (-0.022, -0.018)	0.97a (0.88, 1.04)	0.73	1683
	10 to 20%	-6.8a (-7.2, -6.4)	-0.016a (-0.018, -0.014)	1.04a (0.98, 1.10)	0.77	1016
	>20%	-5.6b (-6.1, -5.1)	-0.016a (-0.019, -0.012)	0.73b (0.61, 0.85)	0.65	524

Summary

- Peatland open water pools are significant sources of C to the atmosphere;
- Pools CO₂ release has a measurable impact on ecosystem level CO₂ exchange;
- Peatland with pools can be sink for CO₂ despite significant C release from the pools;

A wide-angle photograph of a wetland or marsh. The foreground is filled with dark blue water and patches of tall, brownish-reed grass. In the middle ground, the land continues with more of the same vegetation and water. The background features a dense line of green coniferous trees under a vast, light blue sky filled with white and grey clouds.

Thank you