Peatland carbon production and transport: the role of the riparian zone

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Talk Overview

- Project rationale
- Aims & objectives
- Methods/Initial results
    1. Peatland-riparian-stream connectivity.
    2. Ages and sources of carbon.
- Future work
- Conclusions

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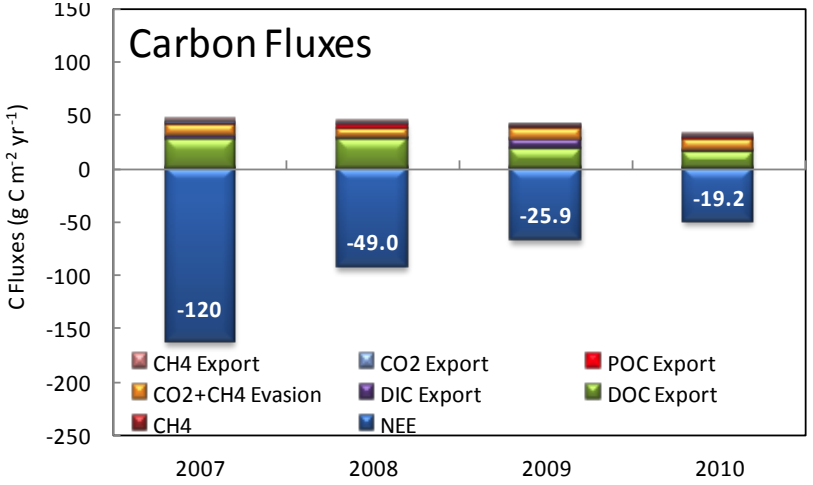
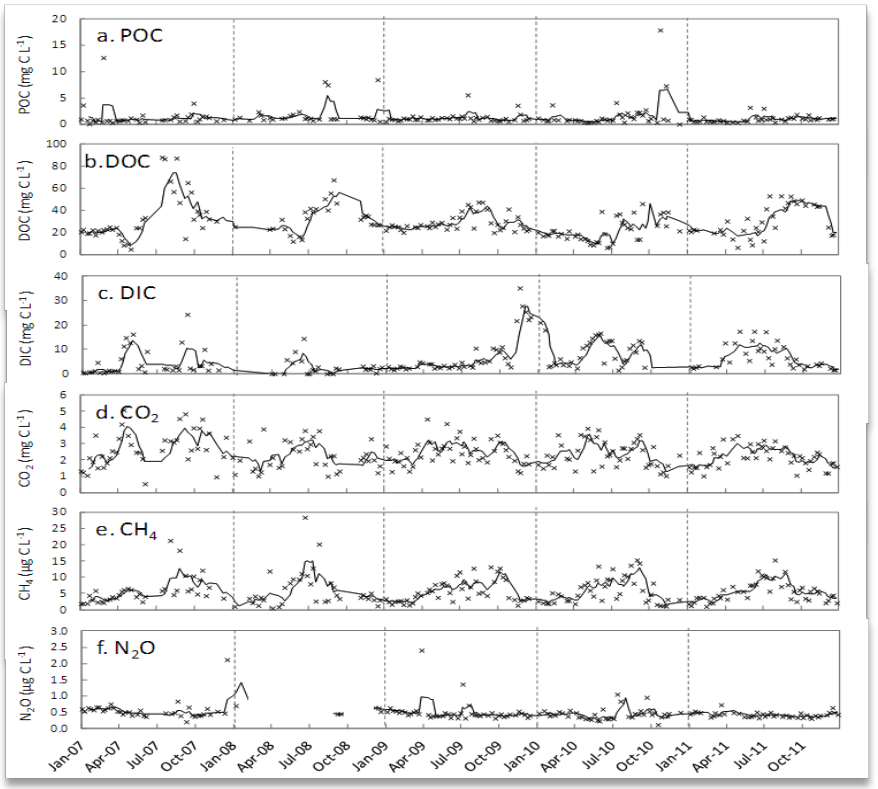
Project rationale

- Aquatic carbon (POC, DOC, DIC, dissolved CO_2, CH_4) fluxes represent ~30% NEE.
- Wealth of background data:
  - NEE since 2002 (Skiba et al. *in review*)
  - 5 year full aquatic budget (Dinsmore et al. *in press*)
- New techniques - Vaisala Carbocap CO_2 sensors





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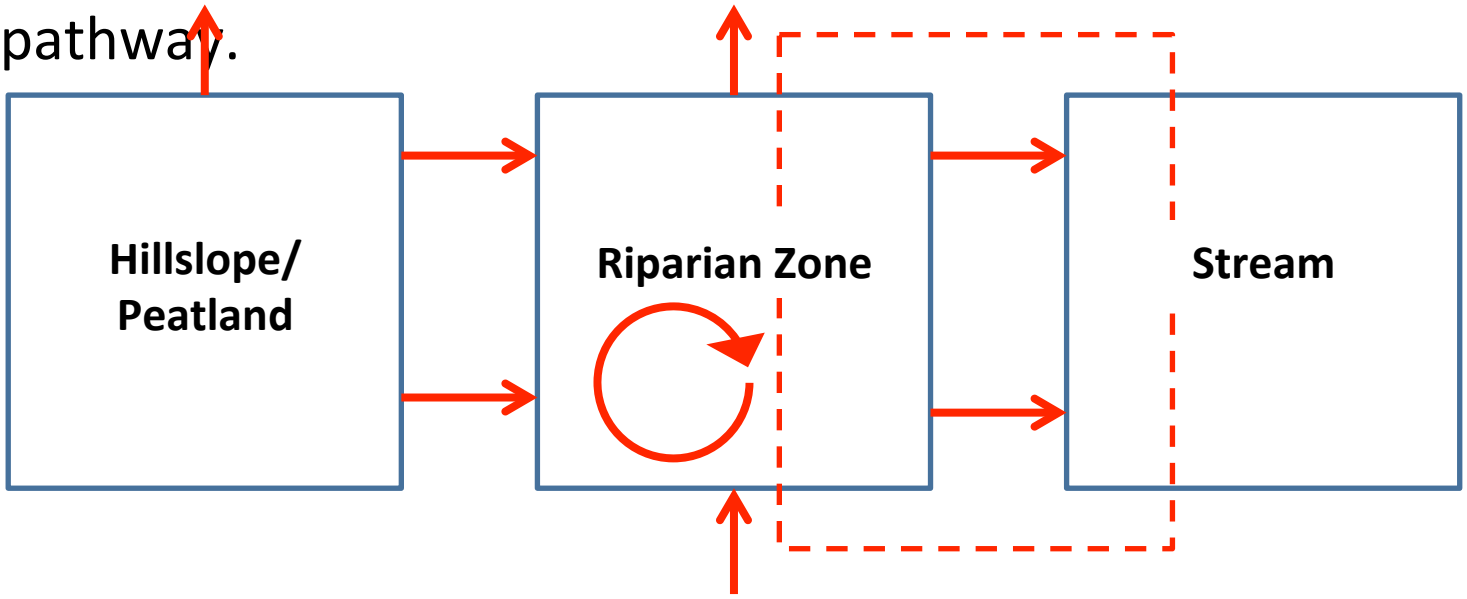
Aims & Objectives

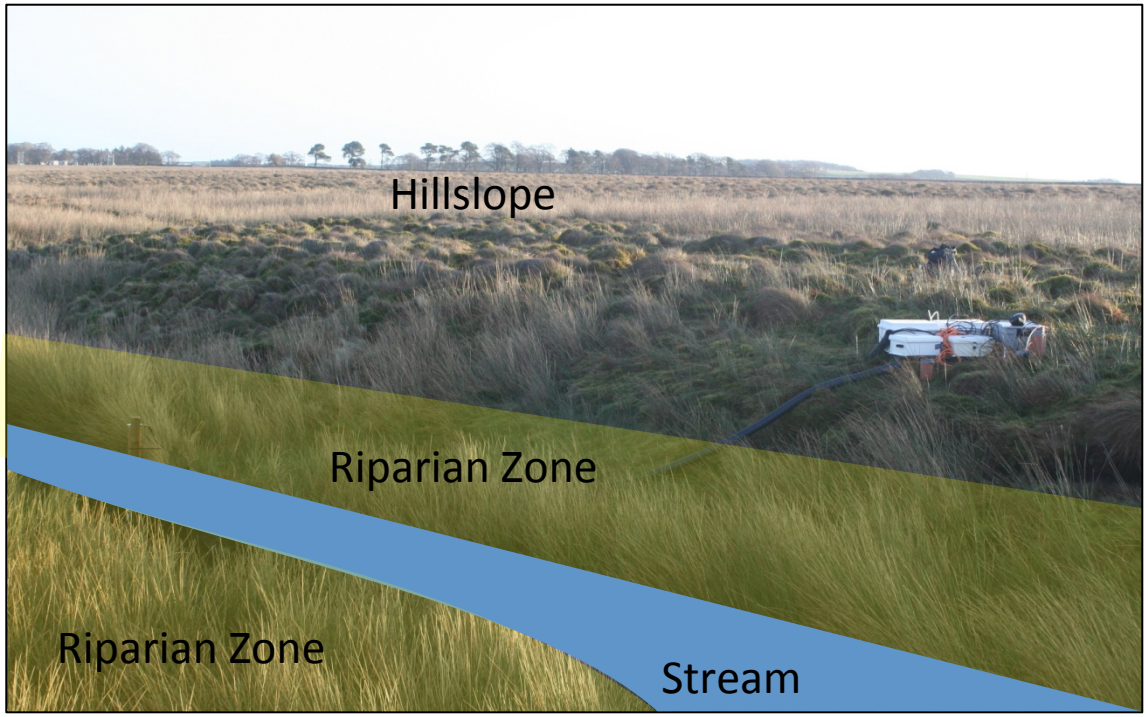
To investigate the **production**, **transformation** and **transport** of aquatic carbon species through peatland riparian zones.

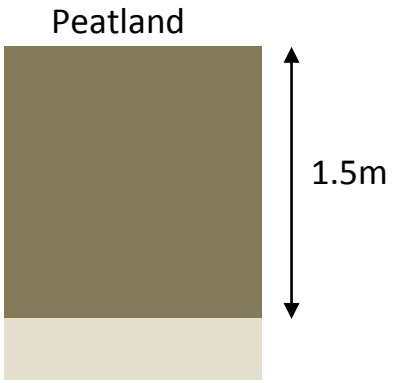
1. Connectivity in the peatland-riparian zone-stream continuum.
2. The age and source of carbon involved in the aquatic pathway.

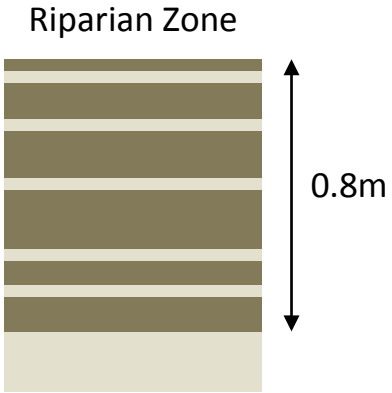


Riparian Zone

1-5 m wide zone adjacent to the stream characterised by: a break in slope, distinct soil and vegetation, higher average water table than hillslope.







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1. Peatland-riparian-stream connectivity

- Auchencorth – 2 sites deep peat v. shallow peat
- Sweden – forested site to contrast processes with Auchencorth.

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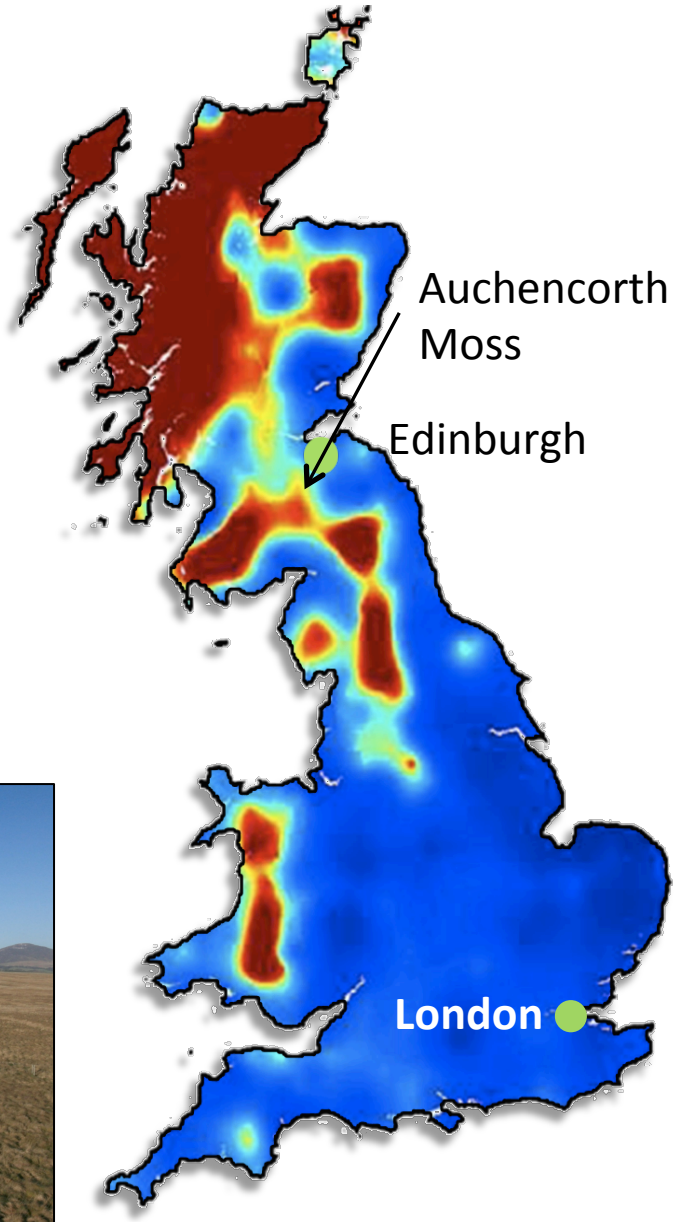
Auchencorth Moss - UK

- 3.4 km^2 low lying ombrotrophic peatland.
- Internationally important field site:
  - CEH Carbon Catchment site
  - EMEP Supersite
  - NitroEurope Supersite.



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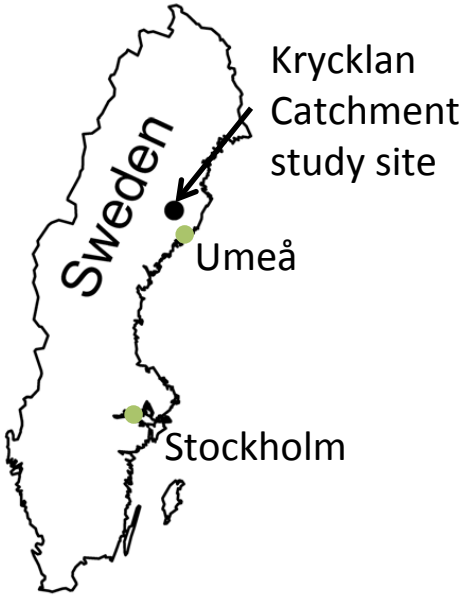
Krycklan Catchment - Sweden

Forested riparian zone of the Västräbacken stream within the Svartberget research area.

Extensively studied site – next to the s-transect and soil frost manipulation studied for over 20 years.



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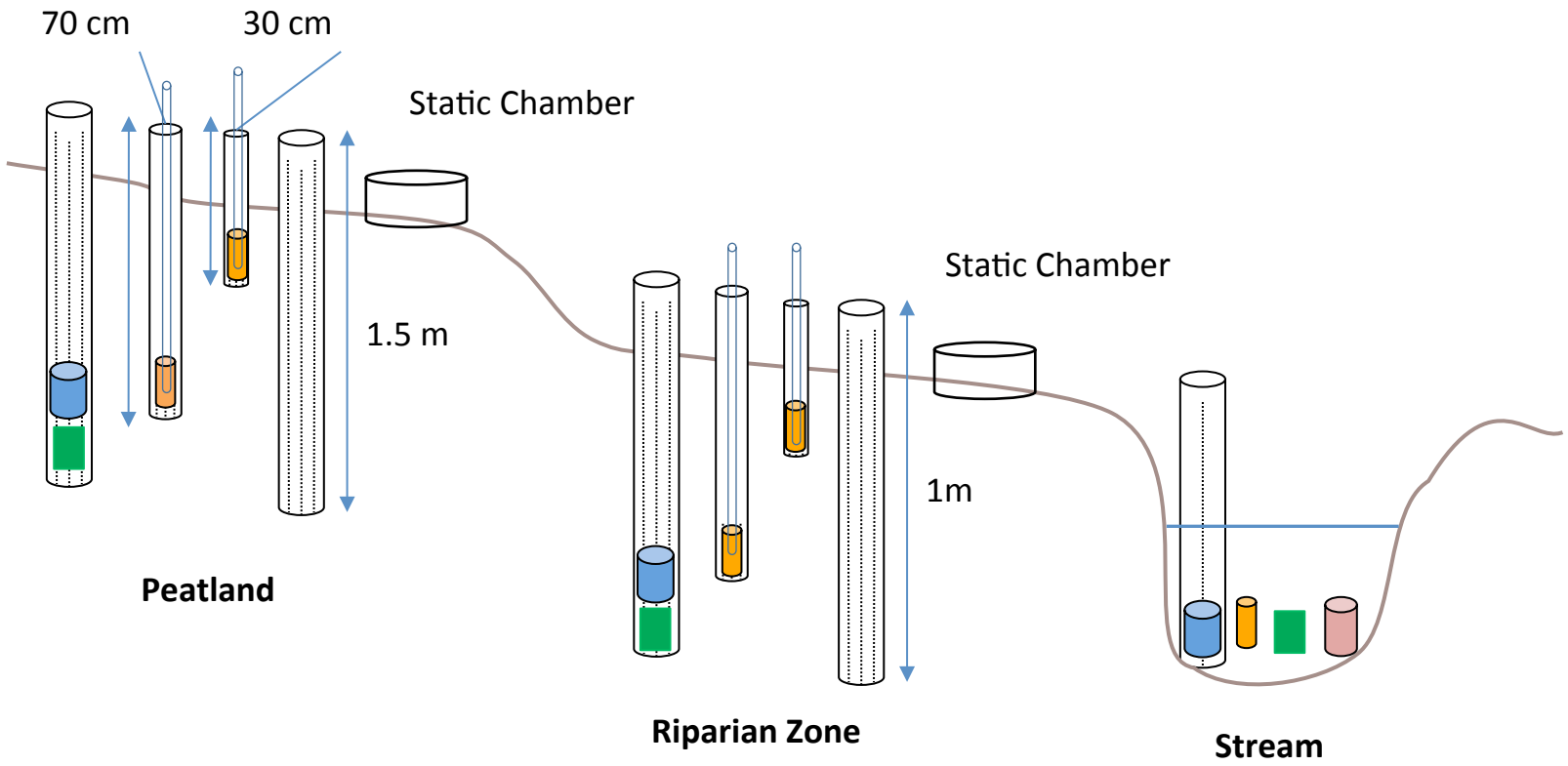
Hillslope-riparian-stream transect



Vaisala Carbocap CO_2 sensor, pressure transducer, temperature/conductivity, pH

10 m

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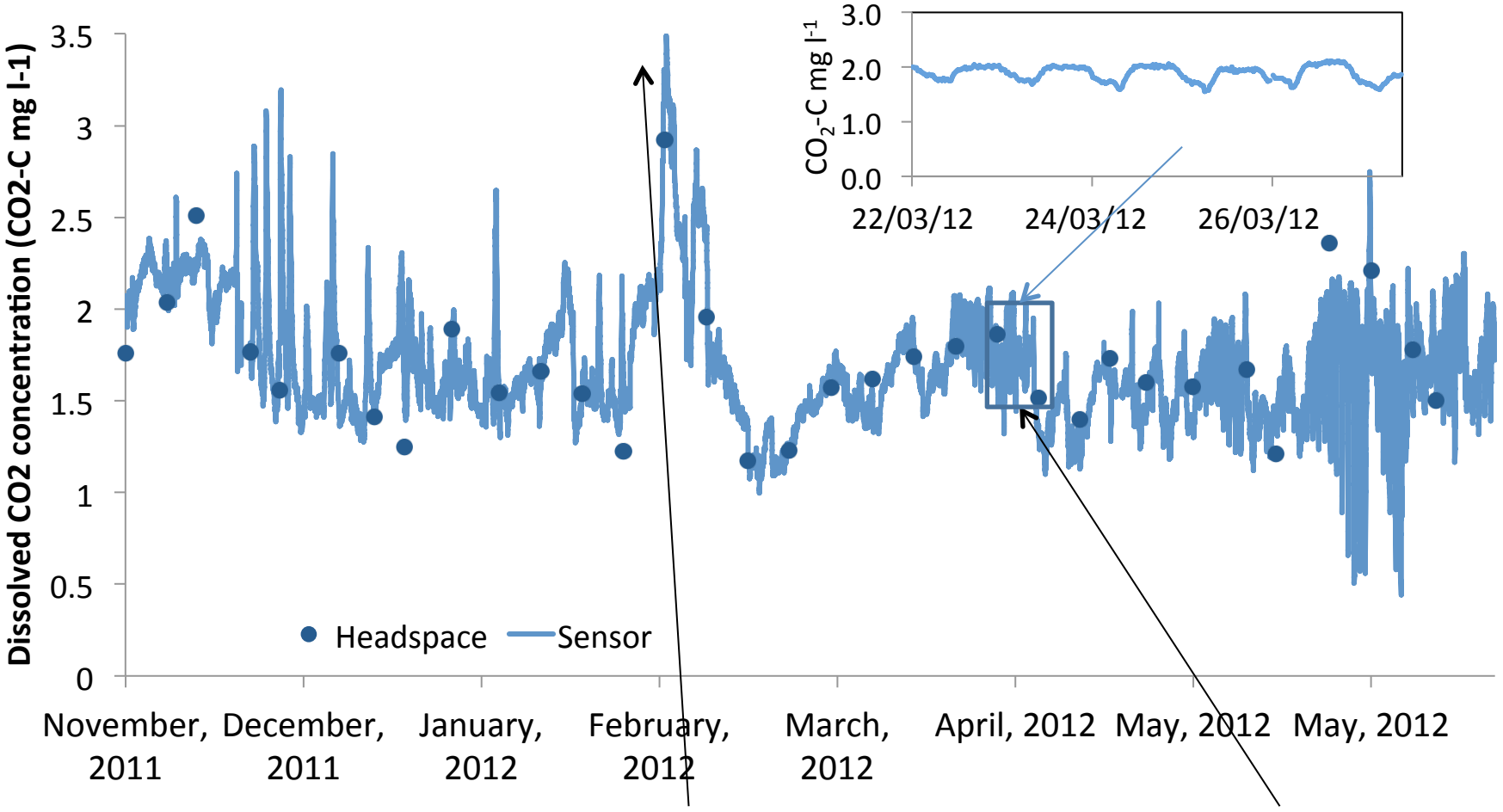
Results – Stream water CO_2



Stream surface iced over so CO_2 building up underneath ice.

When stream level is low diurnal signal can be seen in stream.

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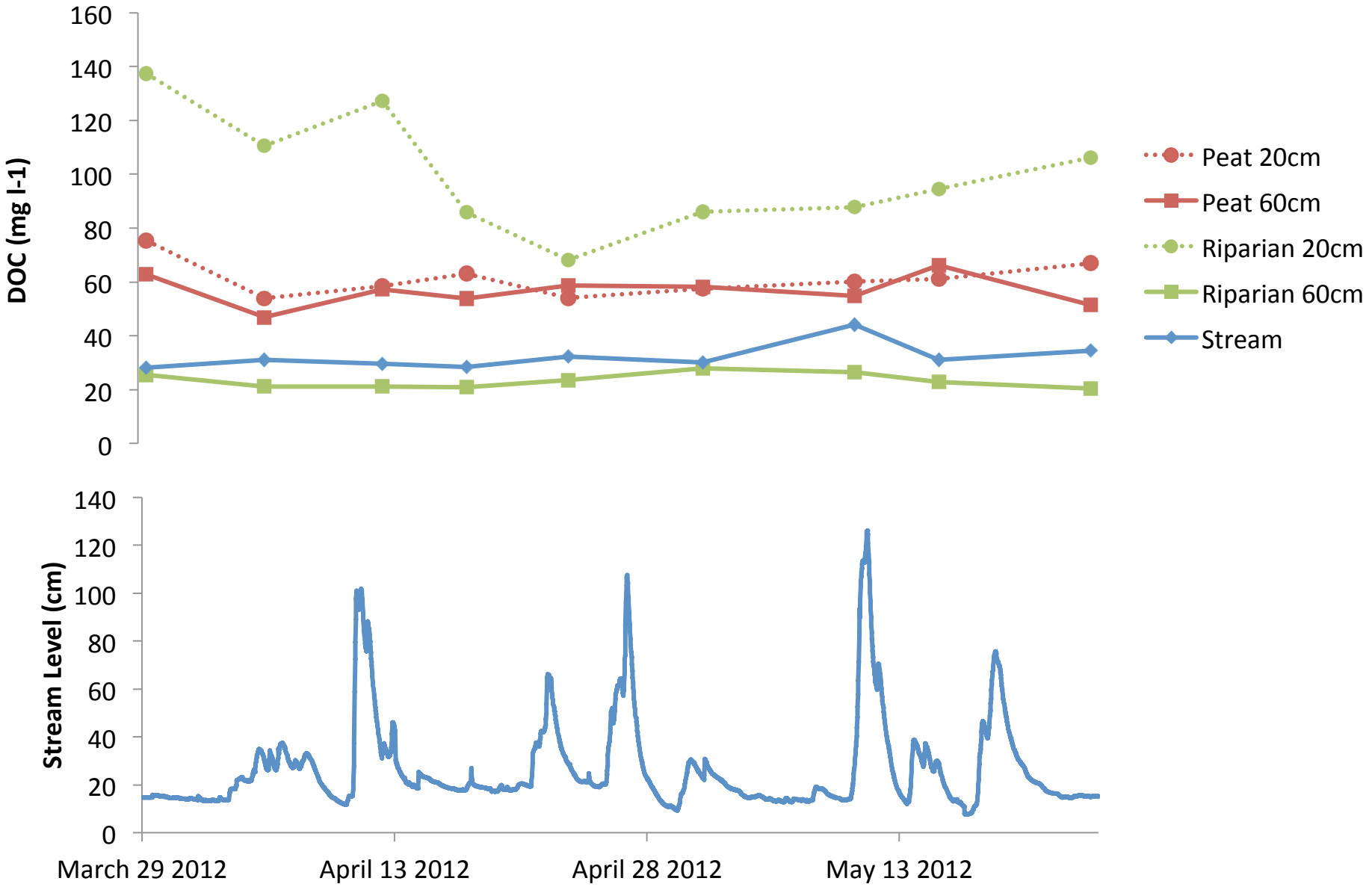
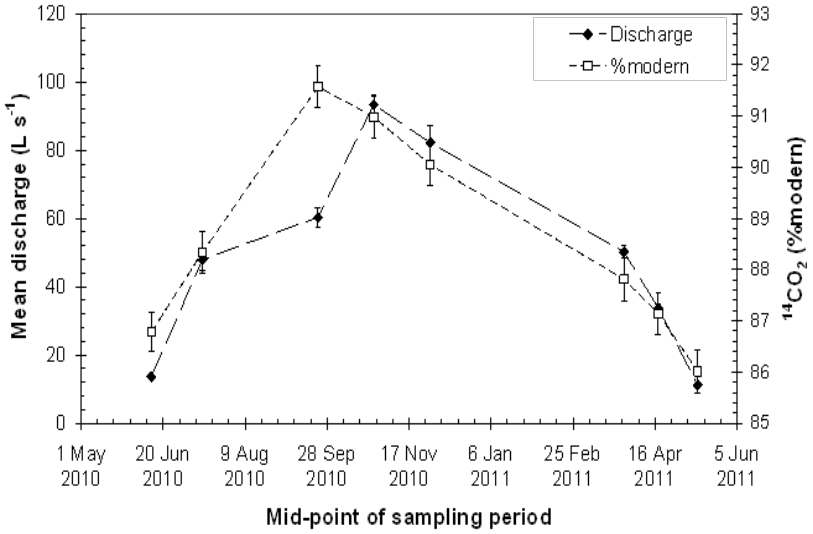
DOC

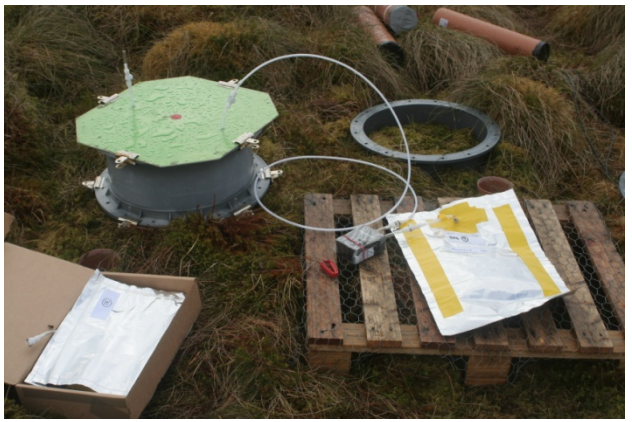

160
140
120
100
80
60
40
20
0
DOC (mg l-1)
Peat 20cm
Peat 60cm
Riparian 20cm
Riparian 60cm
Stream
140
120
100
80
60
40
20
0
Stream Level (cm)
March 29 2012
April 13 2012
April 28 2012
May 13 2012

2. Age and source of aquatic carbon

- Previous studies at Auchencorth have shown that:
  - DOC young (^{14}C age present – 202 years BP)
  - CO_2 is older (^{14}C age 707 – 1210 years BP)

- This study adds methane using method of Garnett et al. 2012b. First study to date methane in peatland-riparian-stream continuum.





Garnett et al. 2012, Science of the Total Environment, 427-428.
Billet et al. 2007, Geophysical Research Letters, (34).
Garnett et al. 2012b, Soil Biology & Biochemistry, (50), 158-163

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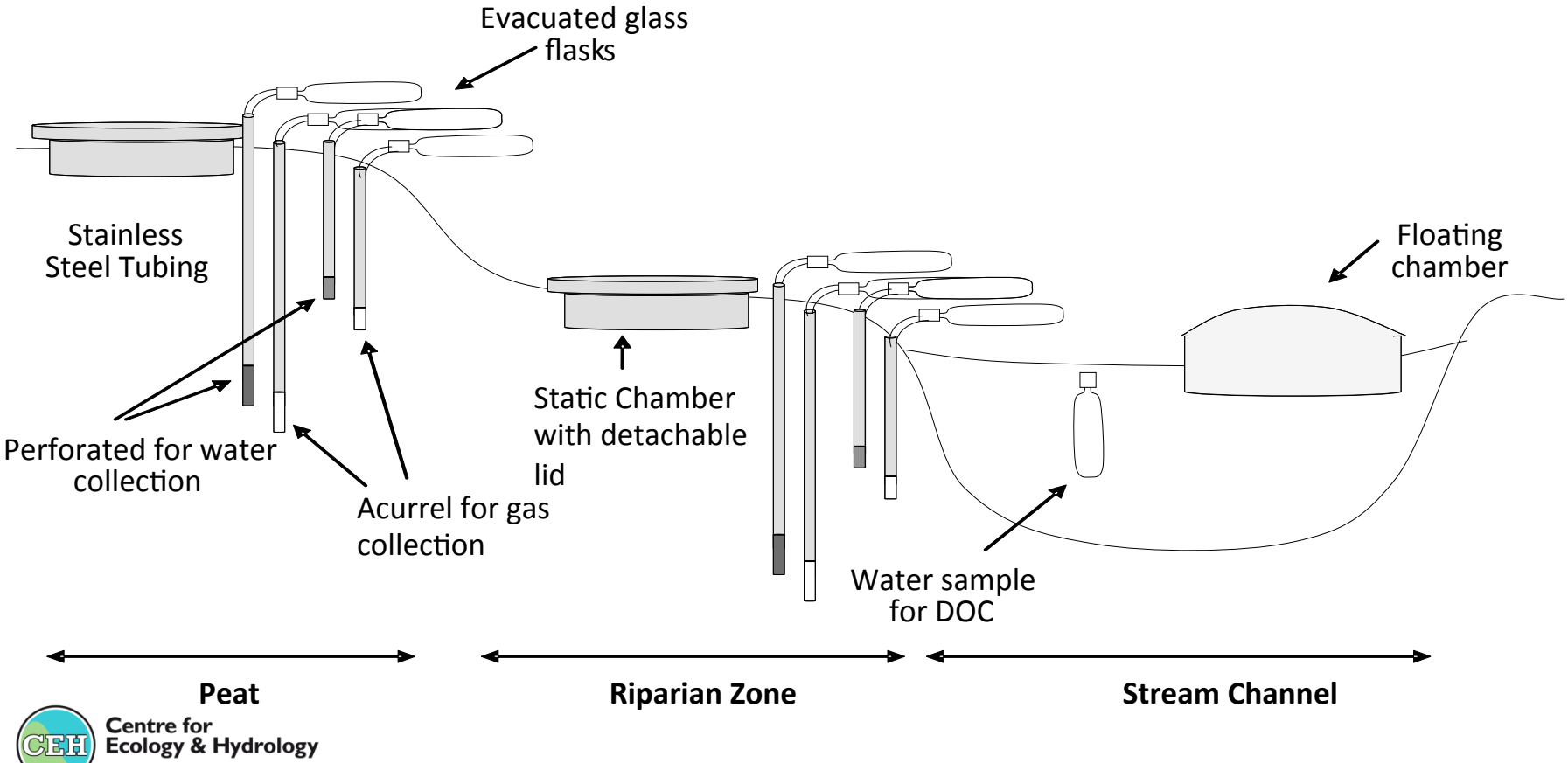
Methods

Determining $\delta^{13}C$ and ^{14}C of: soil atmosphere CH_4 and CO_2, soil and stream water DOC and CO_2 and CH_4 from stream surface evasion and soil surface.



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Future Work

- Krycklan continuing over the summer, Auchencorth continuing until early 2013.

- Additional radiocarbon analysis (August, November). First study to date chamber CH_4 in riparian zone.

- Begin to pick out individual storm events from the time series, hysteresis and hydrograph separation.

Conclusions

1. Riparian zone stream connectivity linked to hydrology.
   - Deep riparian zone and stream connected during base flow.
   - Inputs from shallow surface and peatland during high flow.
2. Importance of continuous sensor data – weekly headspace sampling misses many spikes in CO_2 fluxes.
3. Importance of including riparian zone processes when considering peatland carbon budgeting.

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Thank you

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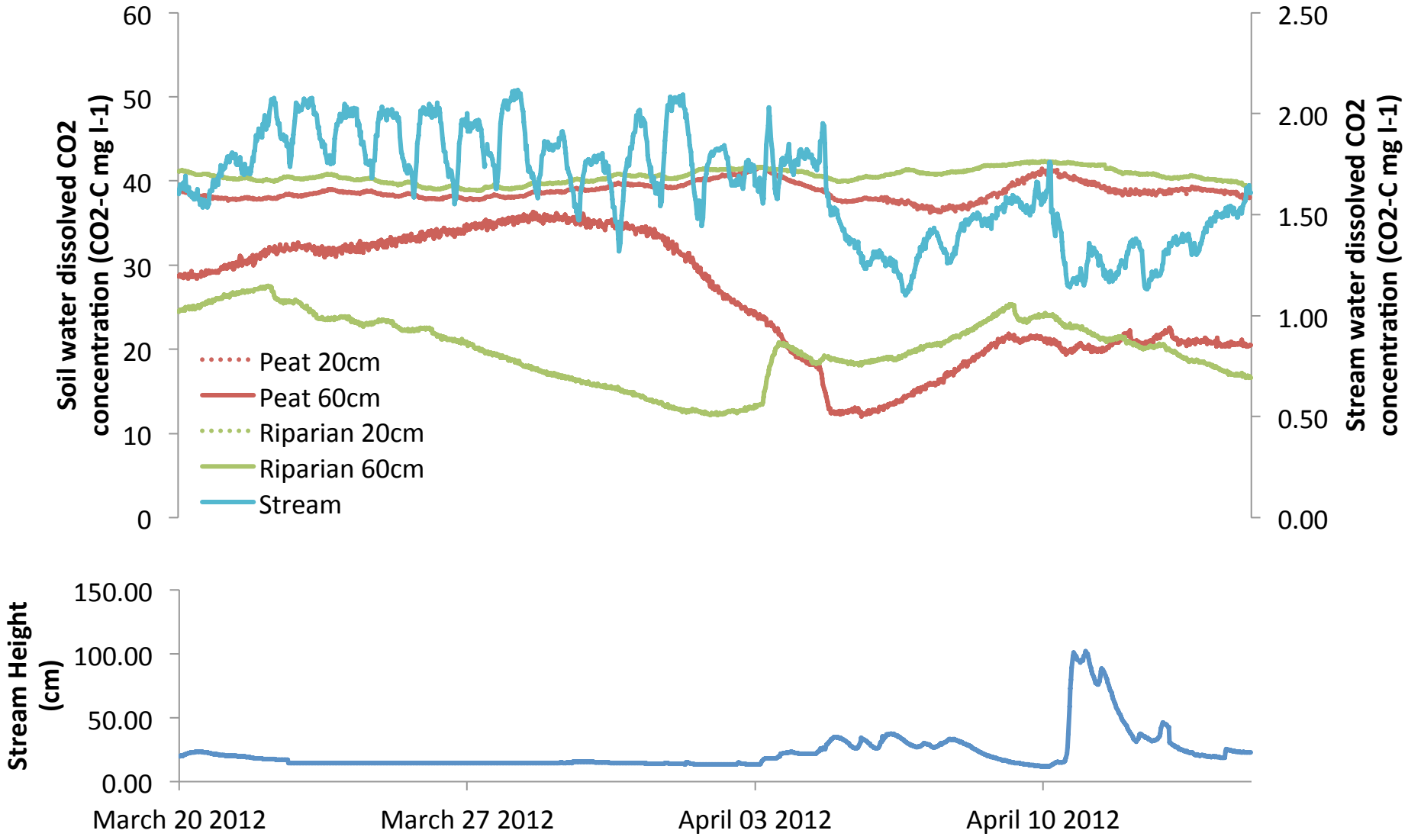
Soil CO_2



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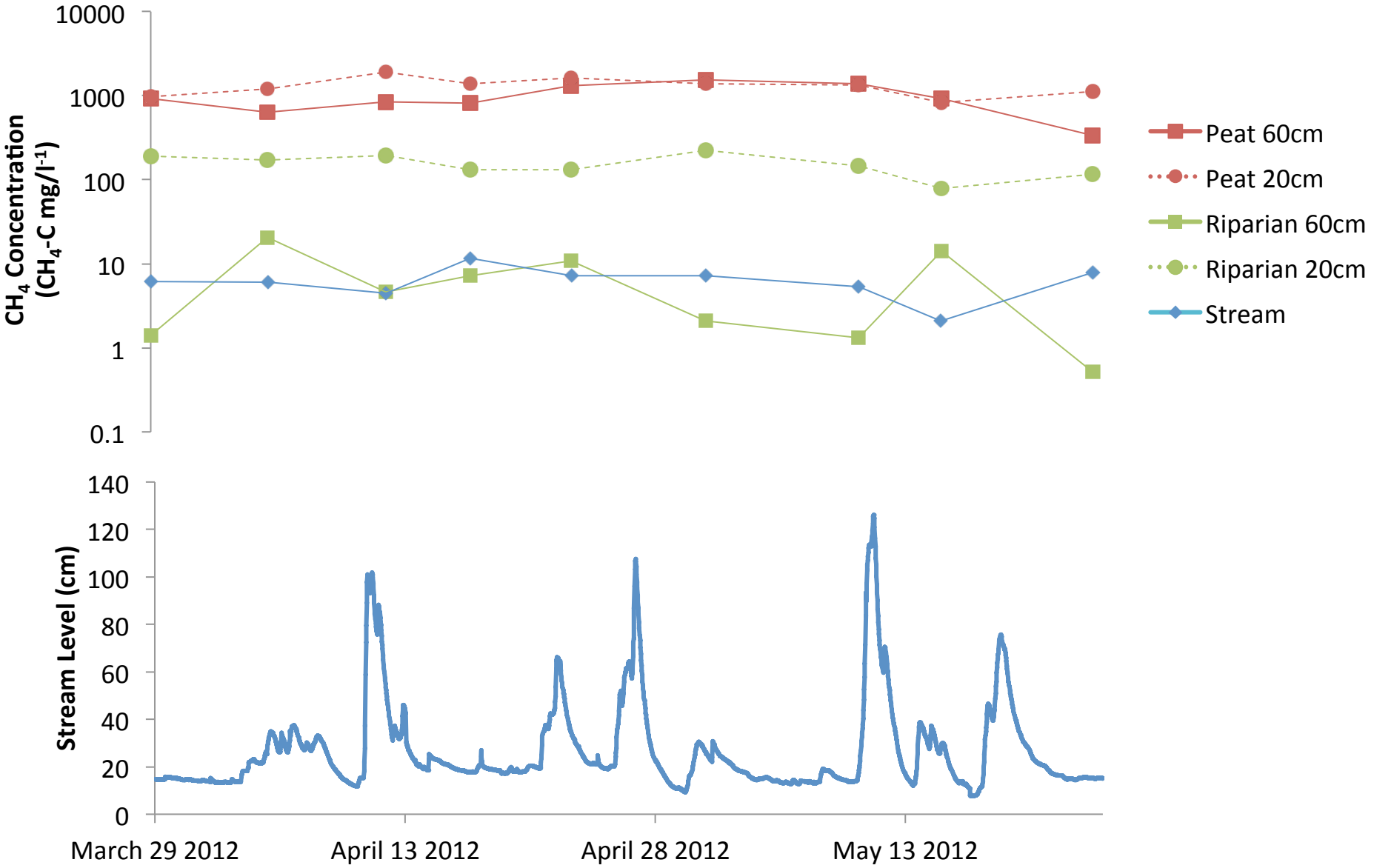
CH_4


10000
1000
100
10
1
0.1
CH4 Concentration (CH4-C mg/l-1)
Peat 60cm
Peat 20cm
Riparian 60cm
Riparian 20cm
Stream
140
120
100
80
60
40
20
0
Stream Level (cm)
March 29 2012
April 13 2012
April 28 2012
May 13 2012