

Carbon cycling in the mixolimnion of Lake Kivu : results from the CAKI project

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S. Bouillon⁵, M. Schmid⁶, N. Pasche⁶, F. Darchambeau²**

¹ Université de Liège, Belgium

² Université de Namur, Belgium

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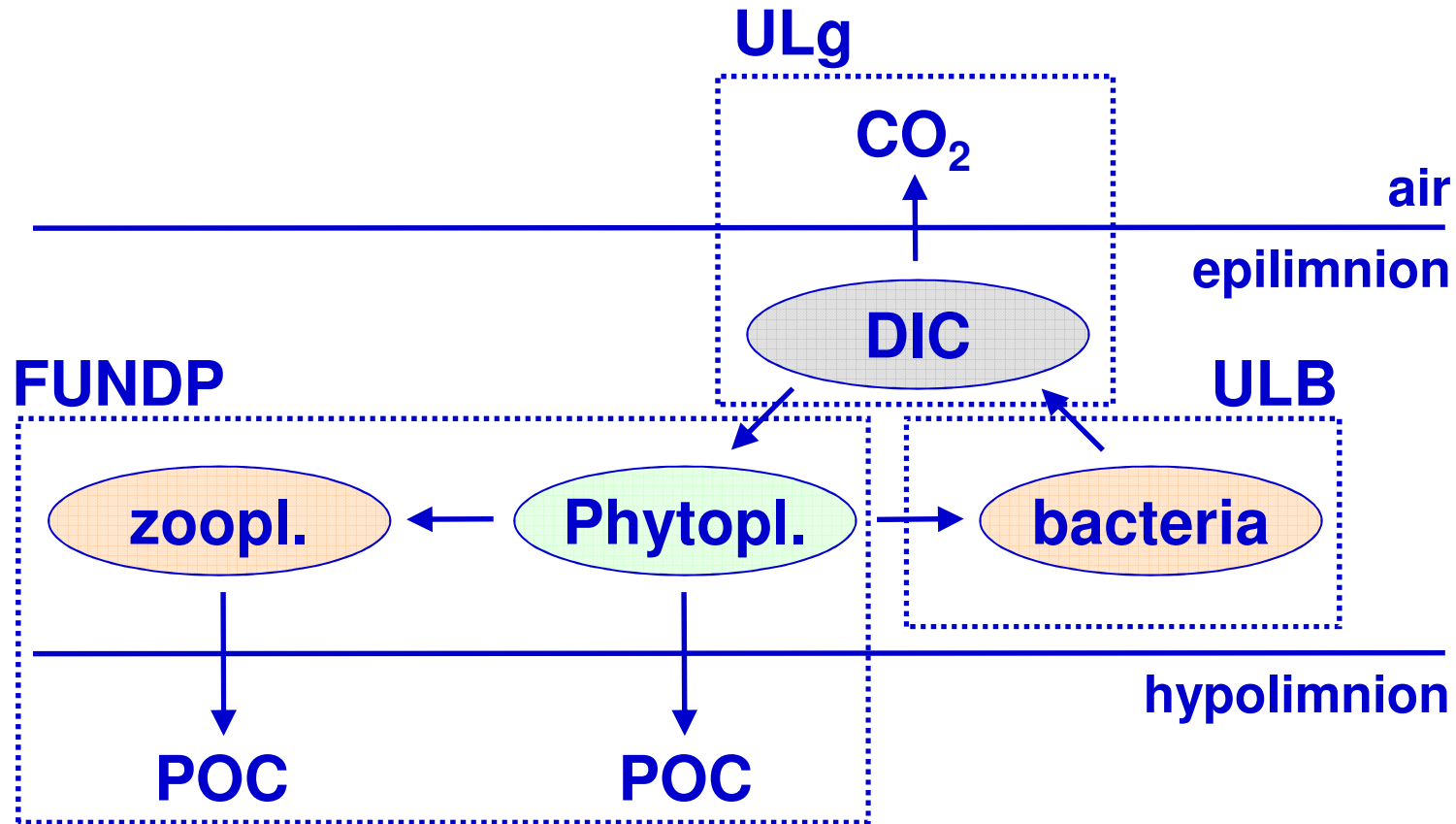
⁴ Université de Bordeaux 1, France

⁵ Katholieke Universiteit Leuven, Belgium

⁶ EAWAG, Surface Waters Research and Management, Switzerland

Carbon and Nutrient cycles in lake Kivu (CAKI)

FNRS funded



$\delta^{13}\text{C}$ DIC measurements : S. Bouillon / F. Dehairs / J.J. Middelburg

CH_4 measurements : G. Abril

Zooplankton, nutrients measurements : ISP (RDC) & UNR (Rwanda)

CO₂ & CH₄ in lake Kivu

Bottom high CO_2 , higher temperature and salinity = geothermal inputs
Bottom high CH_4 = degradation at depth of organic matter from surface

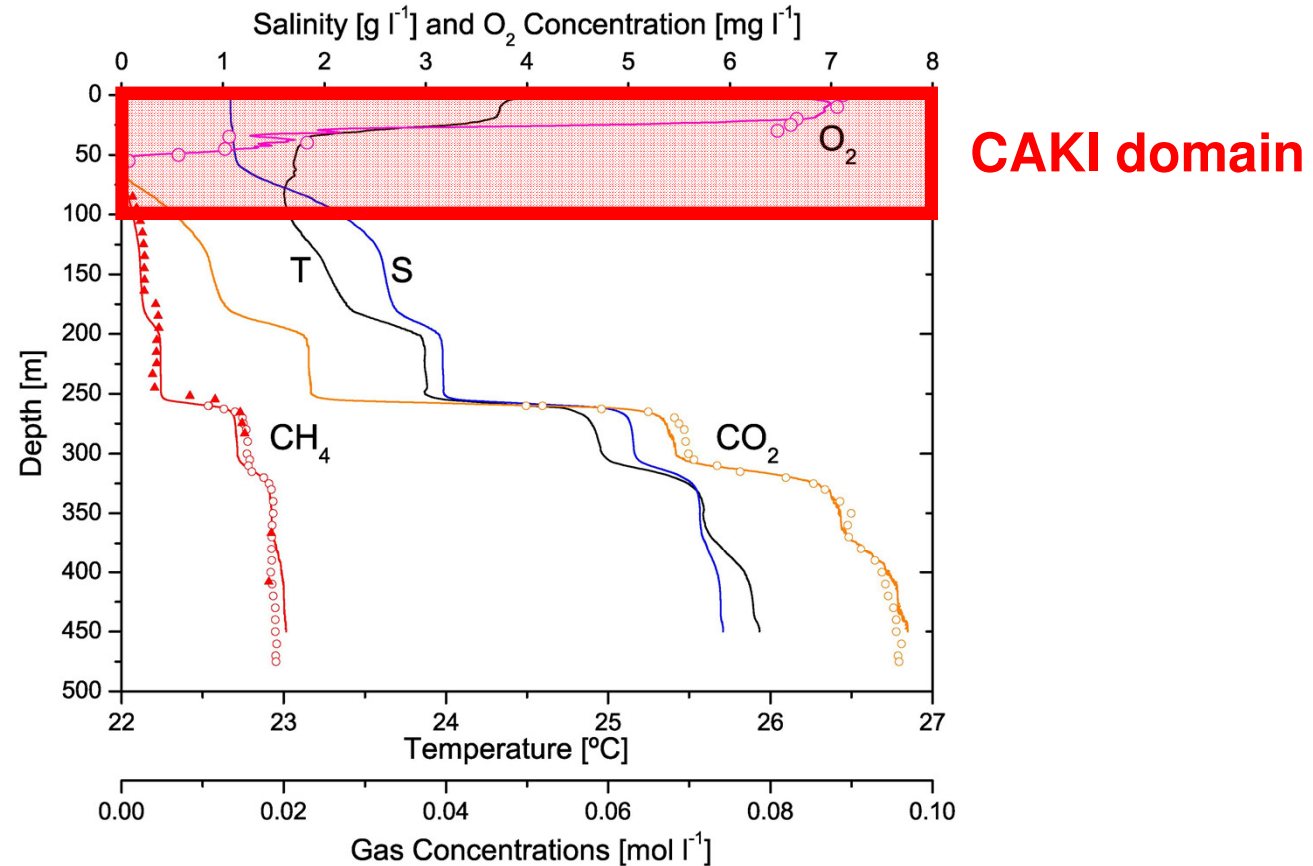
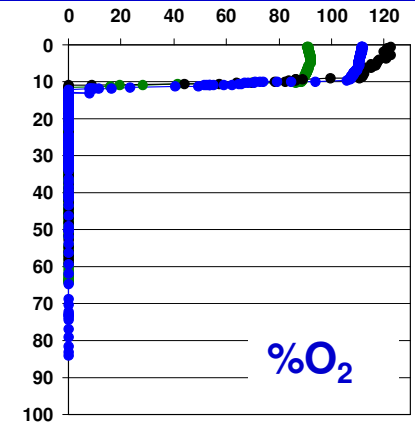
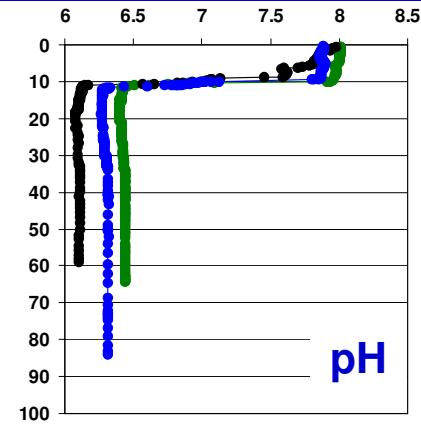
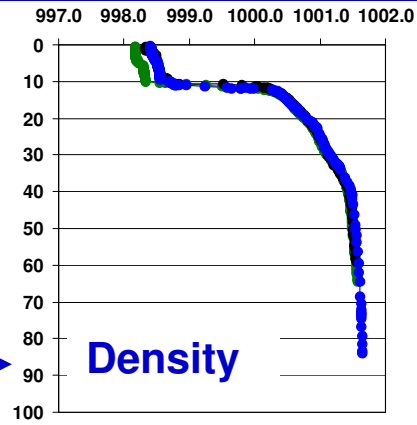
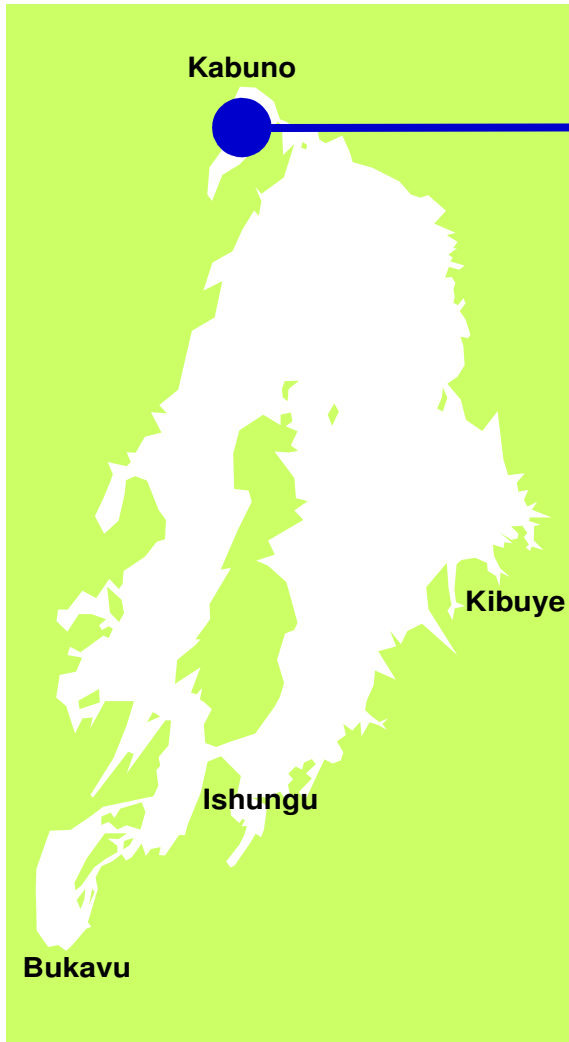


Figure 2. Vertical profiles of temperature (T), salinity (S), and dissolved gas concentrations in Lake Kivu in February 2004. The orange line is the CO_2 concentration calculated from pH and alkalinity, the red line is the CH_4 concentration assuming a constant CH_4/CO_2 ratio, the open circles show the gas concentrations measured in November 2003, and the triangles show the CH_4 concentrations measured with the Capsum Mets sensor. The oxygen concentrations measured with the CTD probe and using the Winkler method are shown by the magenta line and the magenta circles, respectively.

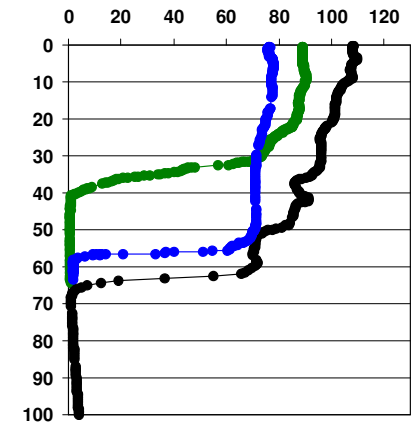
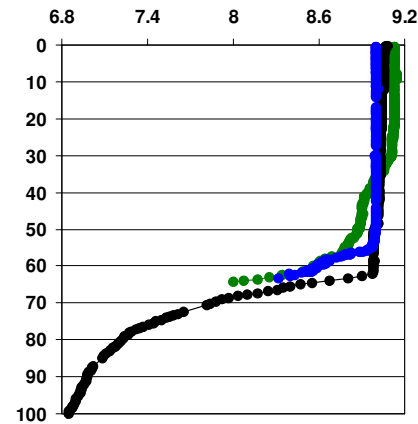
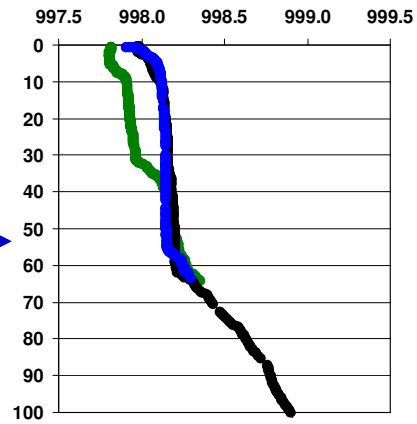
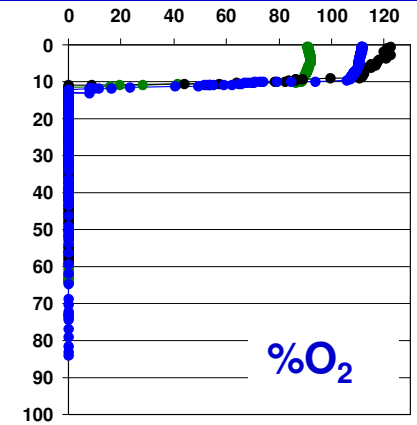
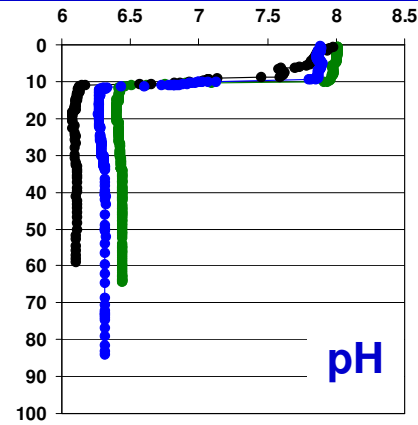
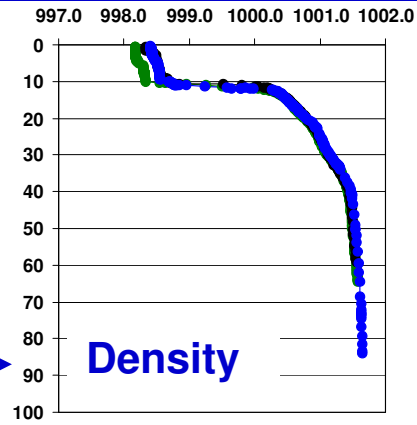
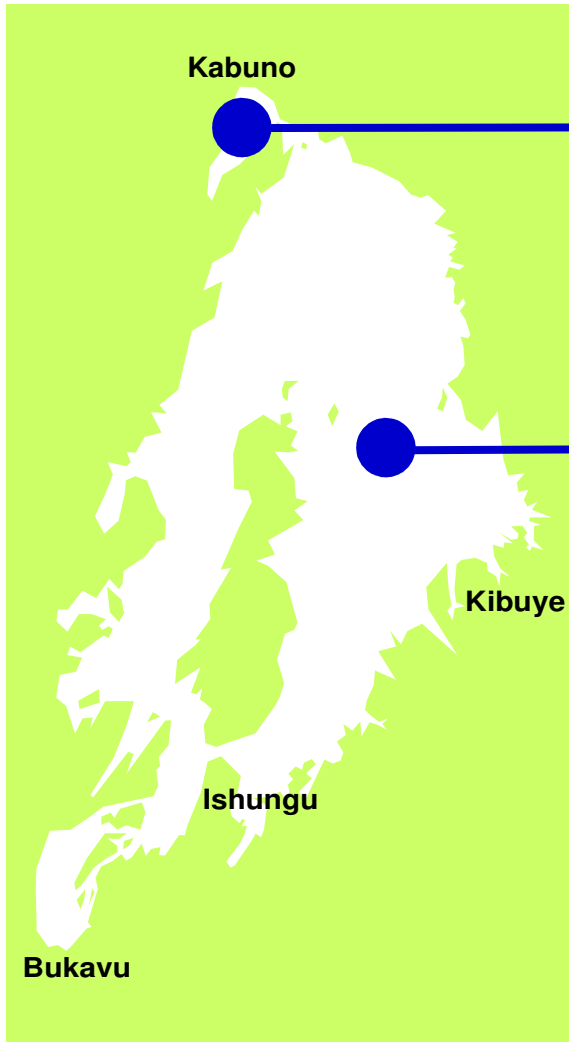
Seasonal variability

March 2007 (rainy)
Sept. 2007 (late-dry)
June 2008 (mid-dry)



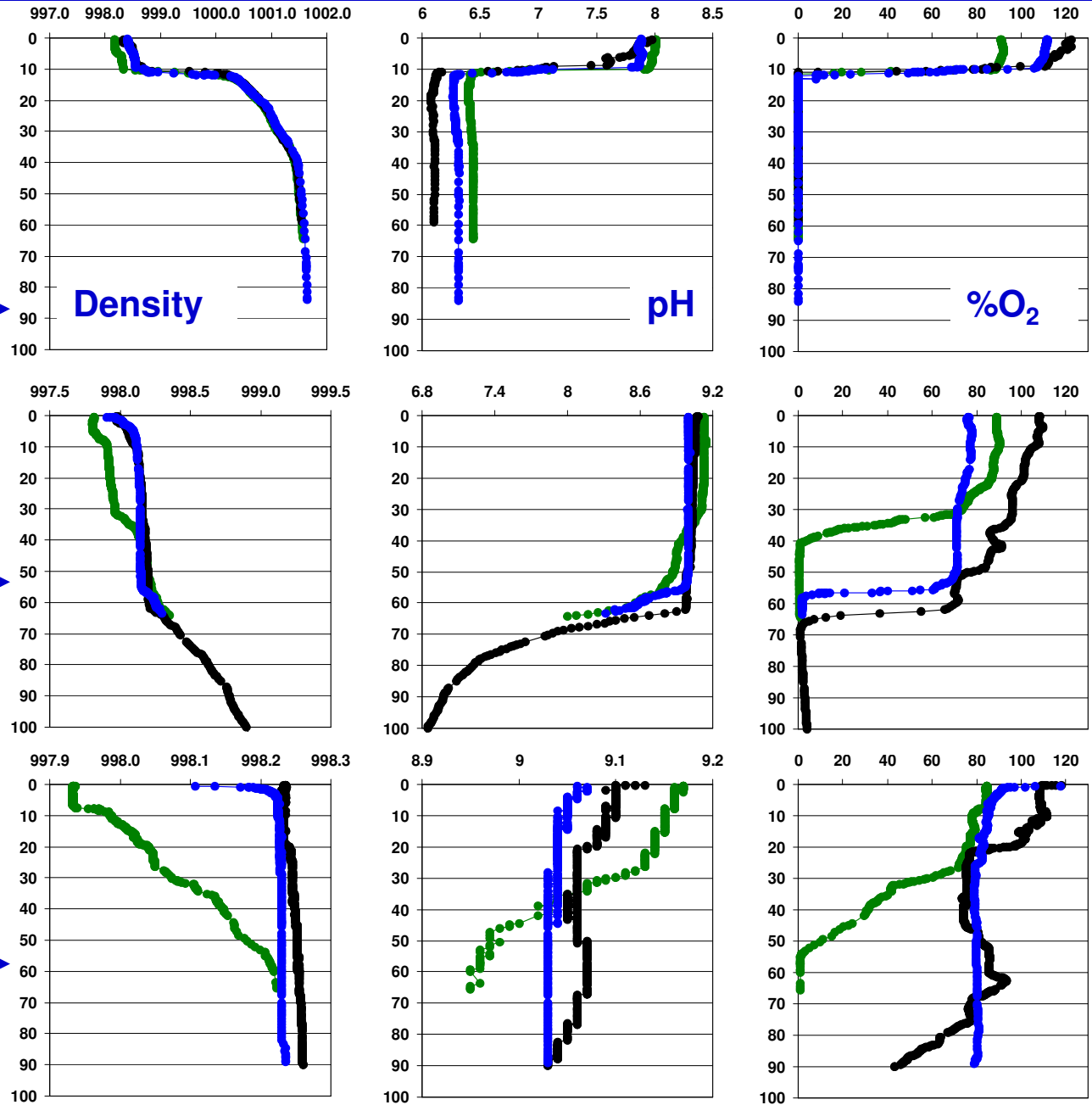
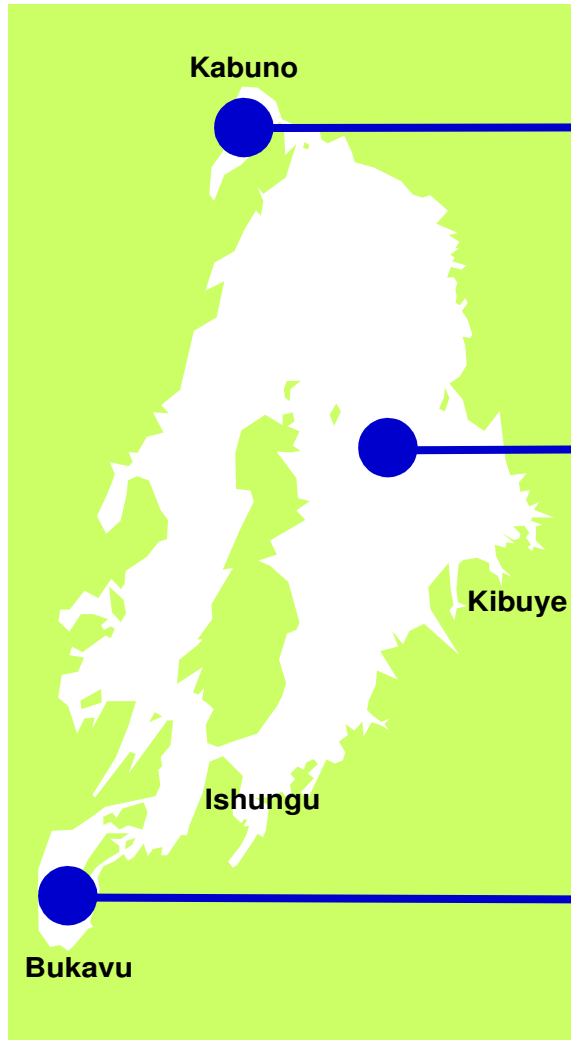
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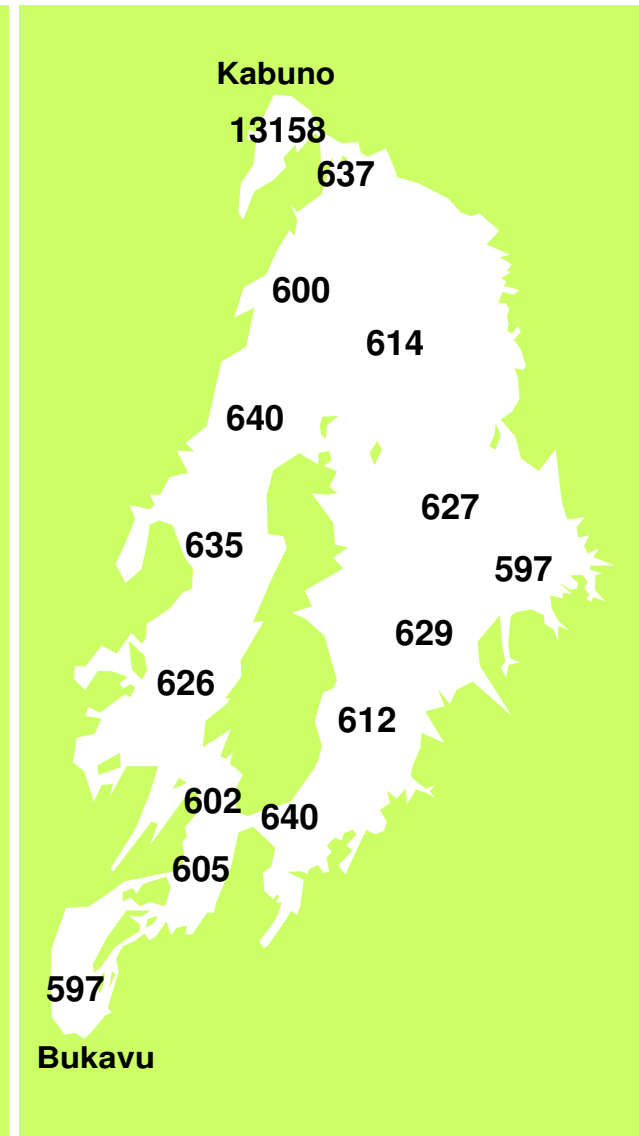
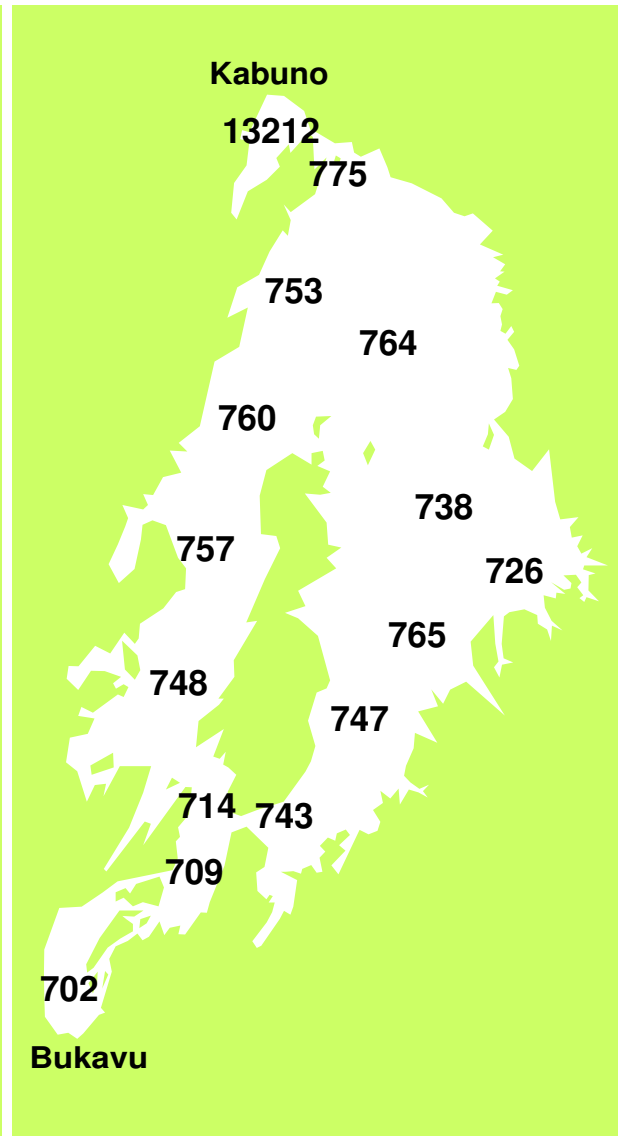
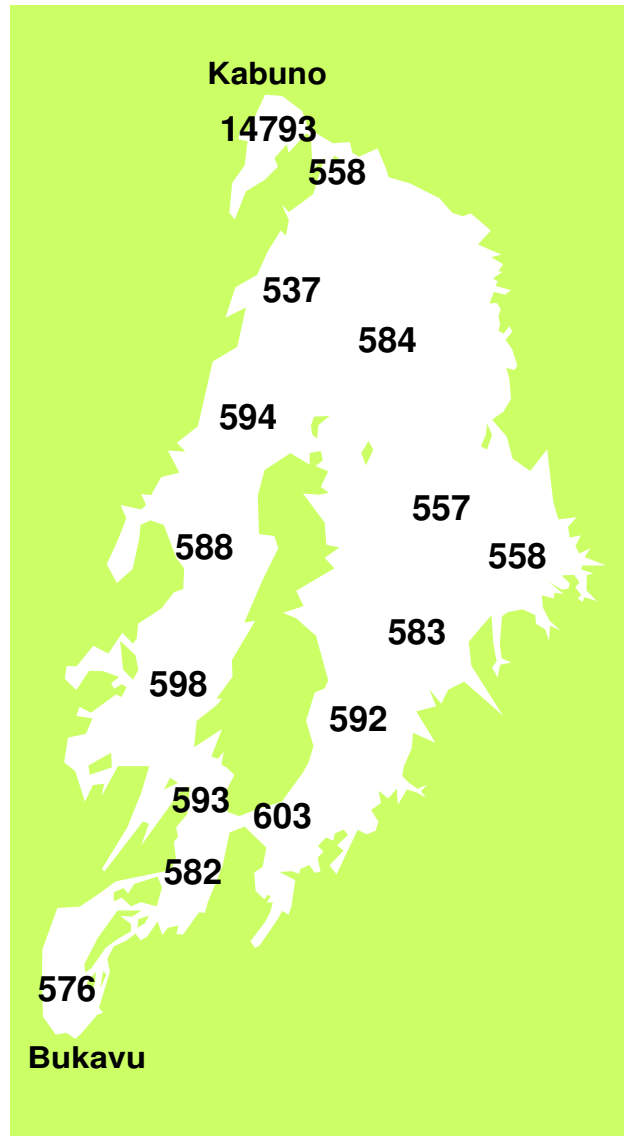
Seasonal variability

pCO₂

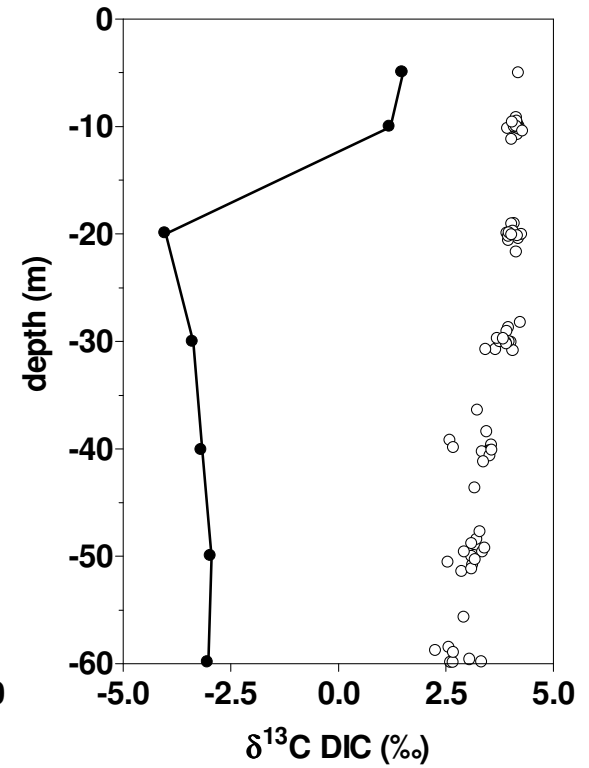
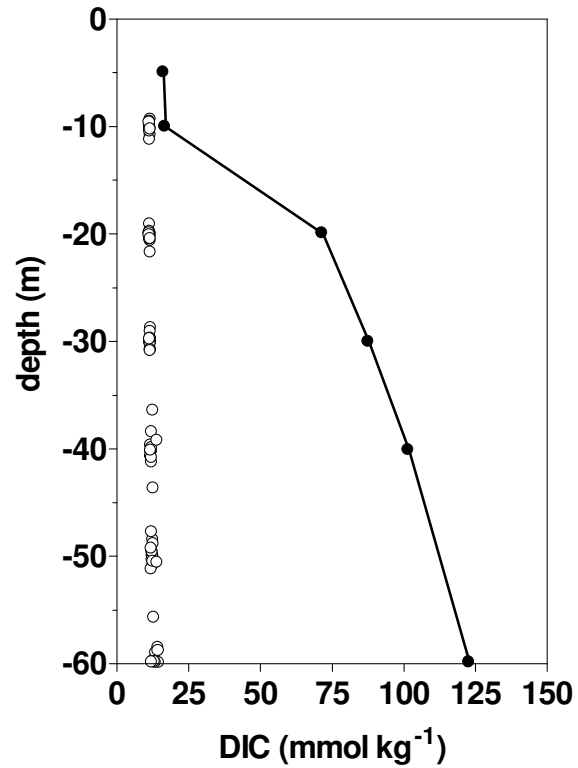
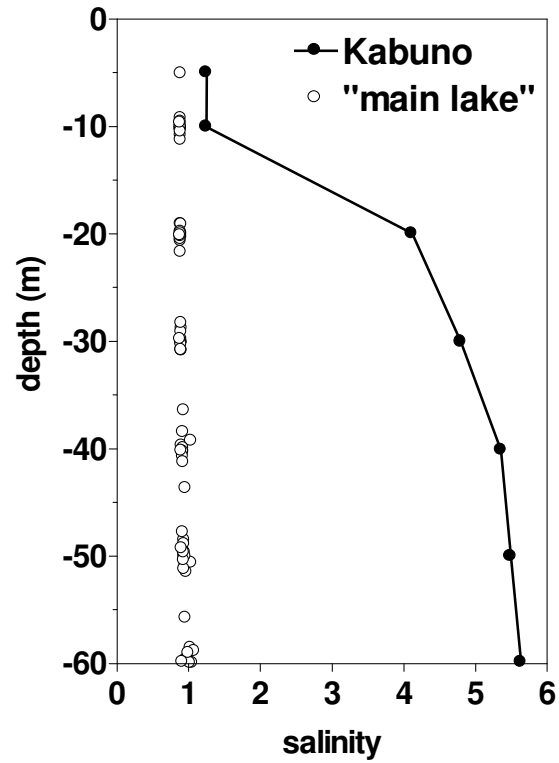
March 2007

September 2007

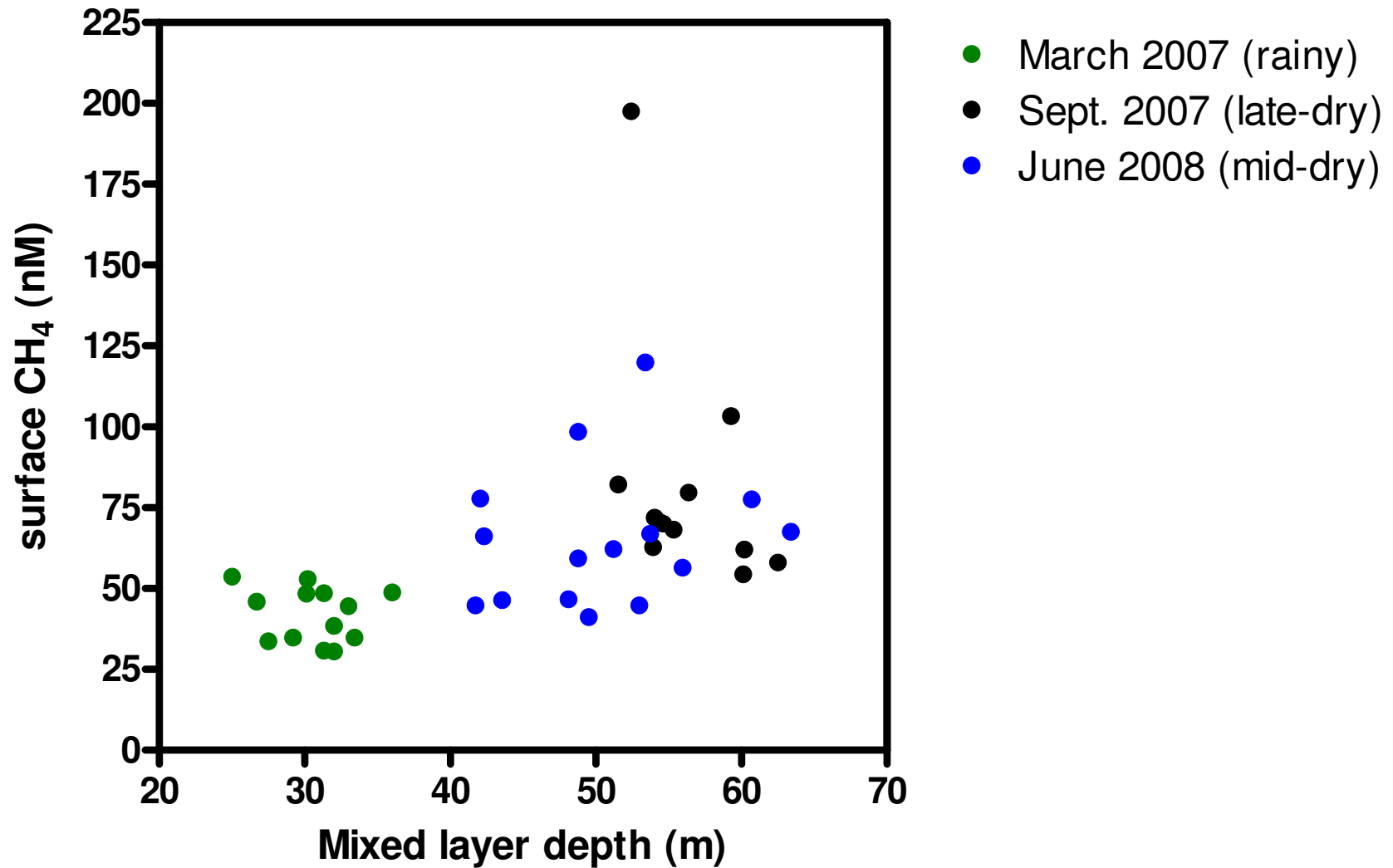
June 2008



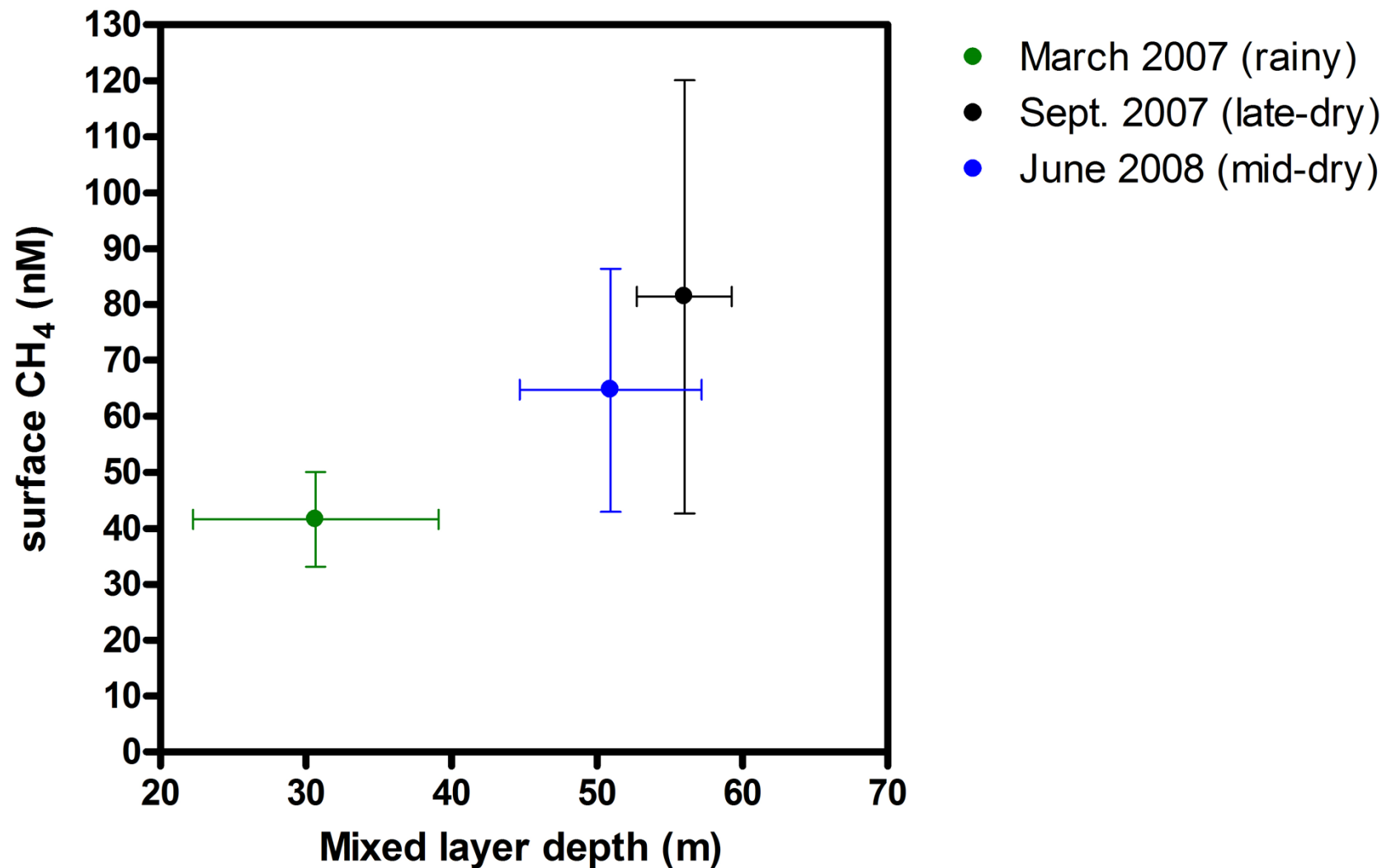
Seasonal variability



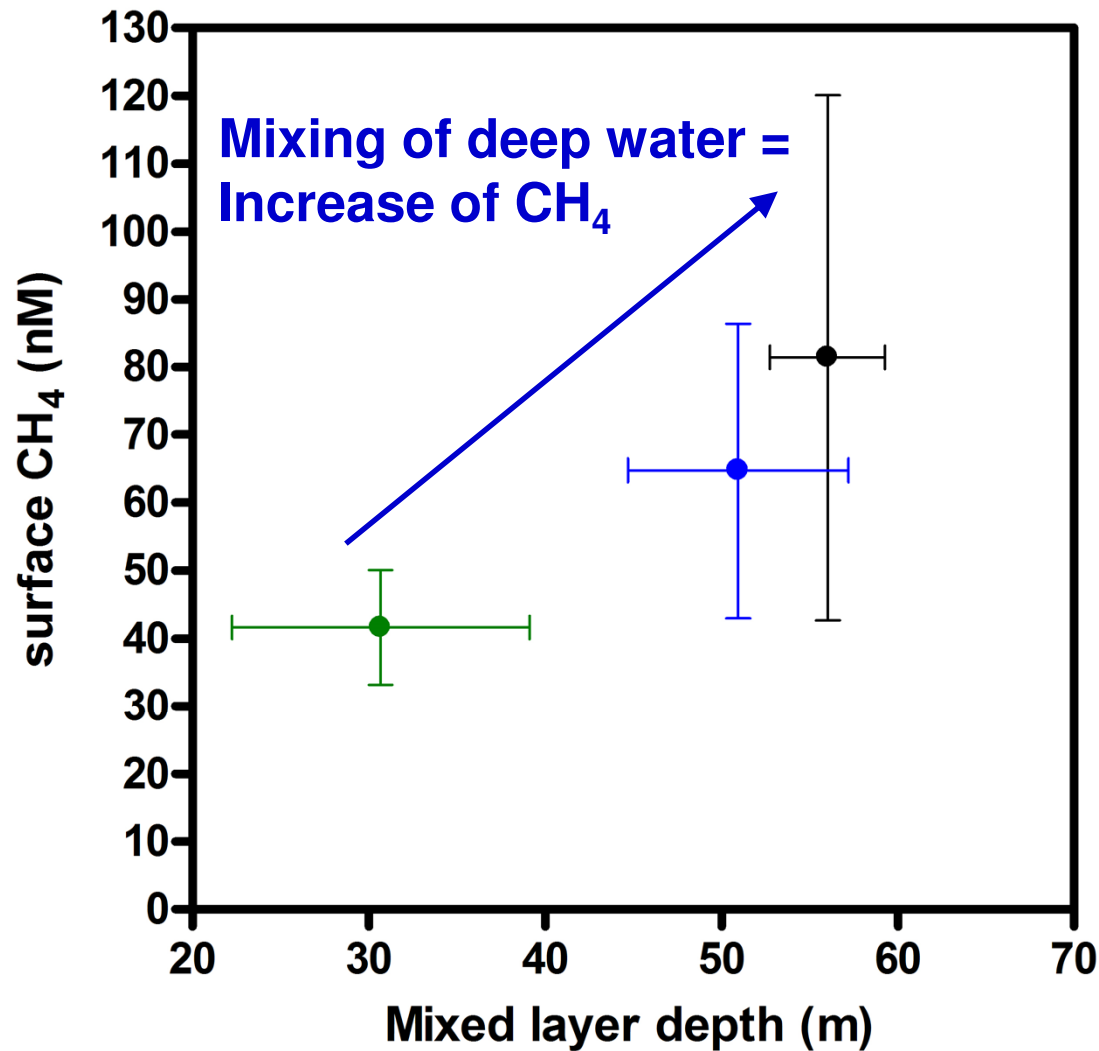
Seasonal variability



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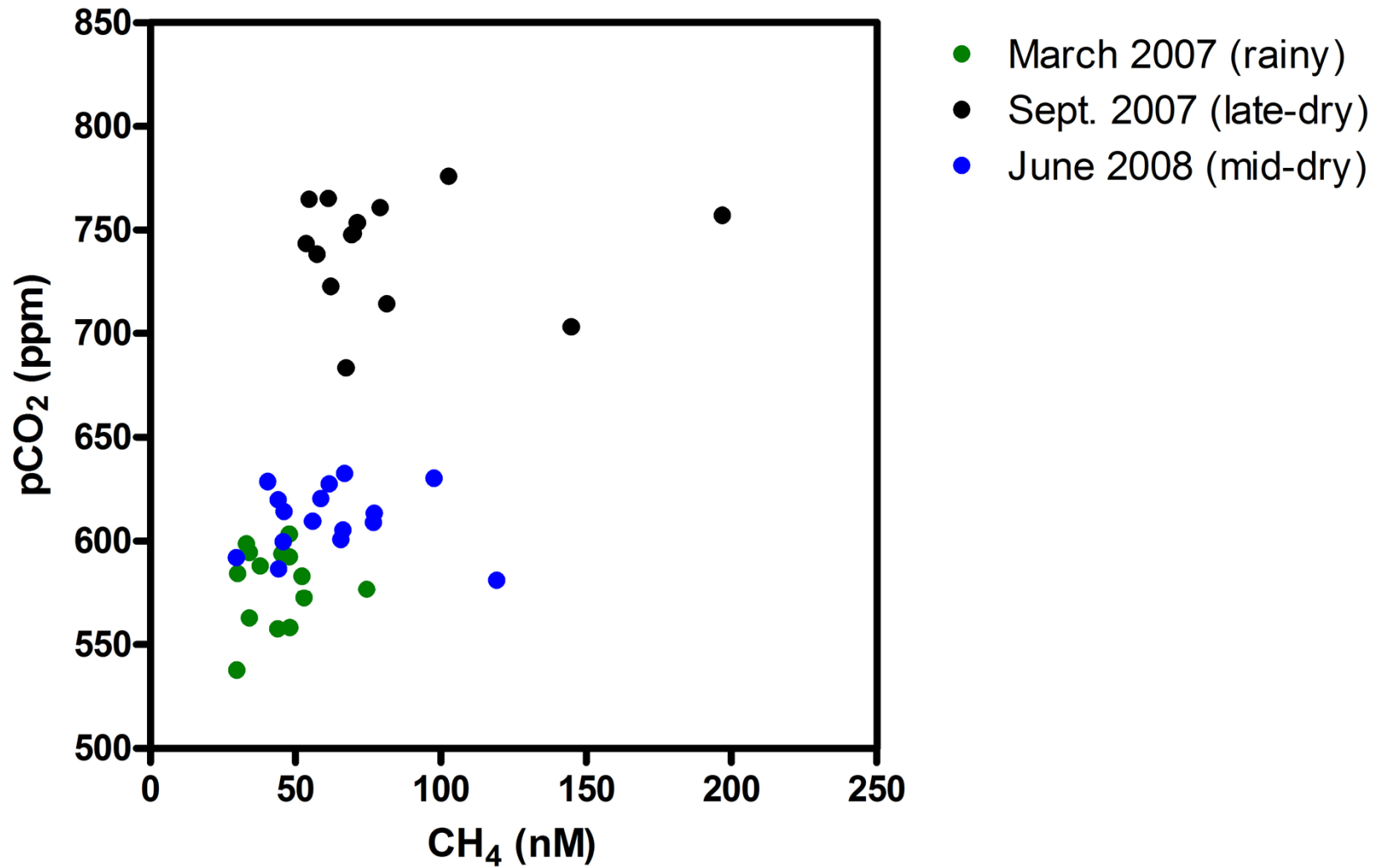


Seasonal variability

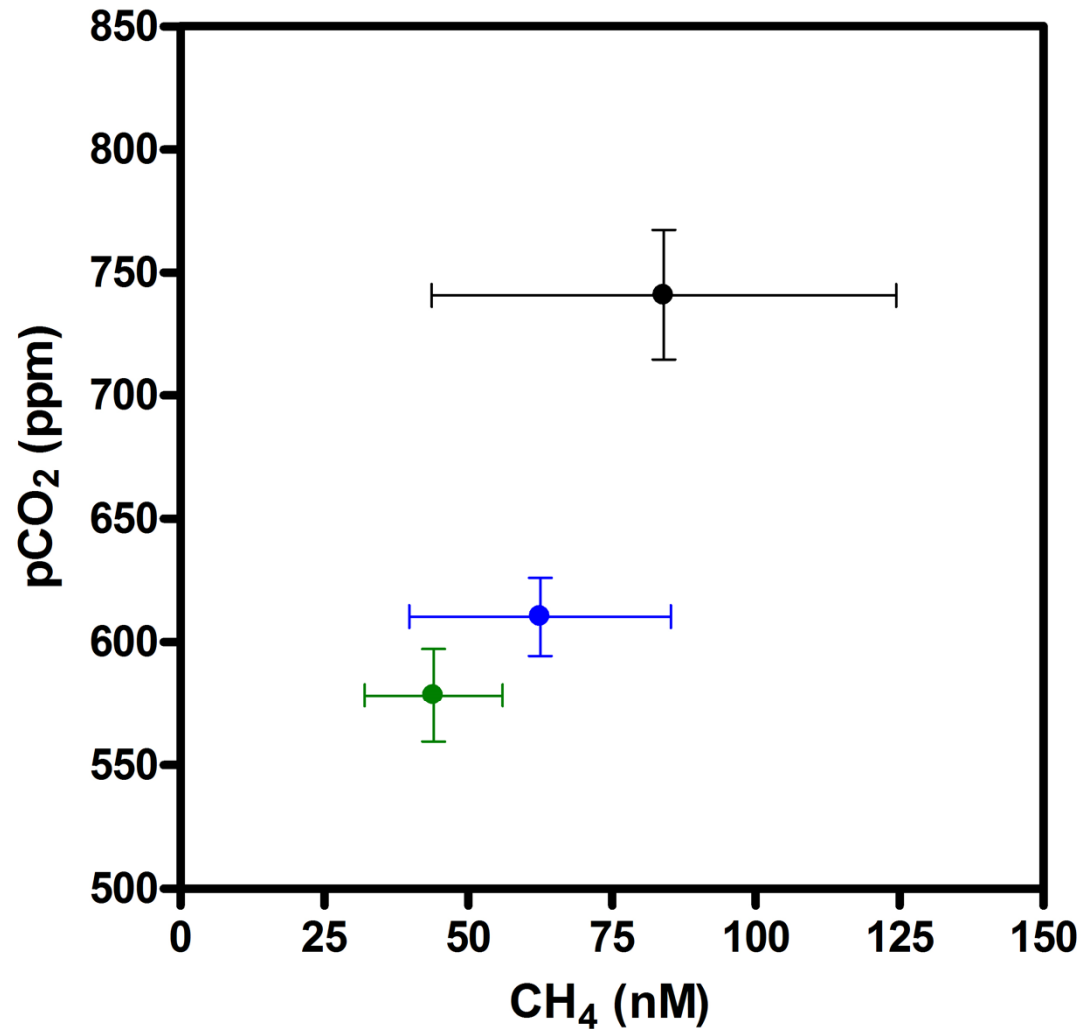


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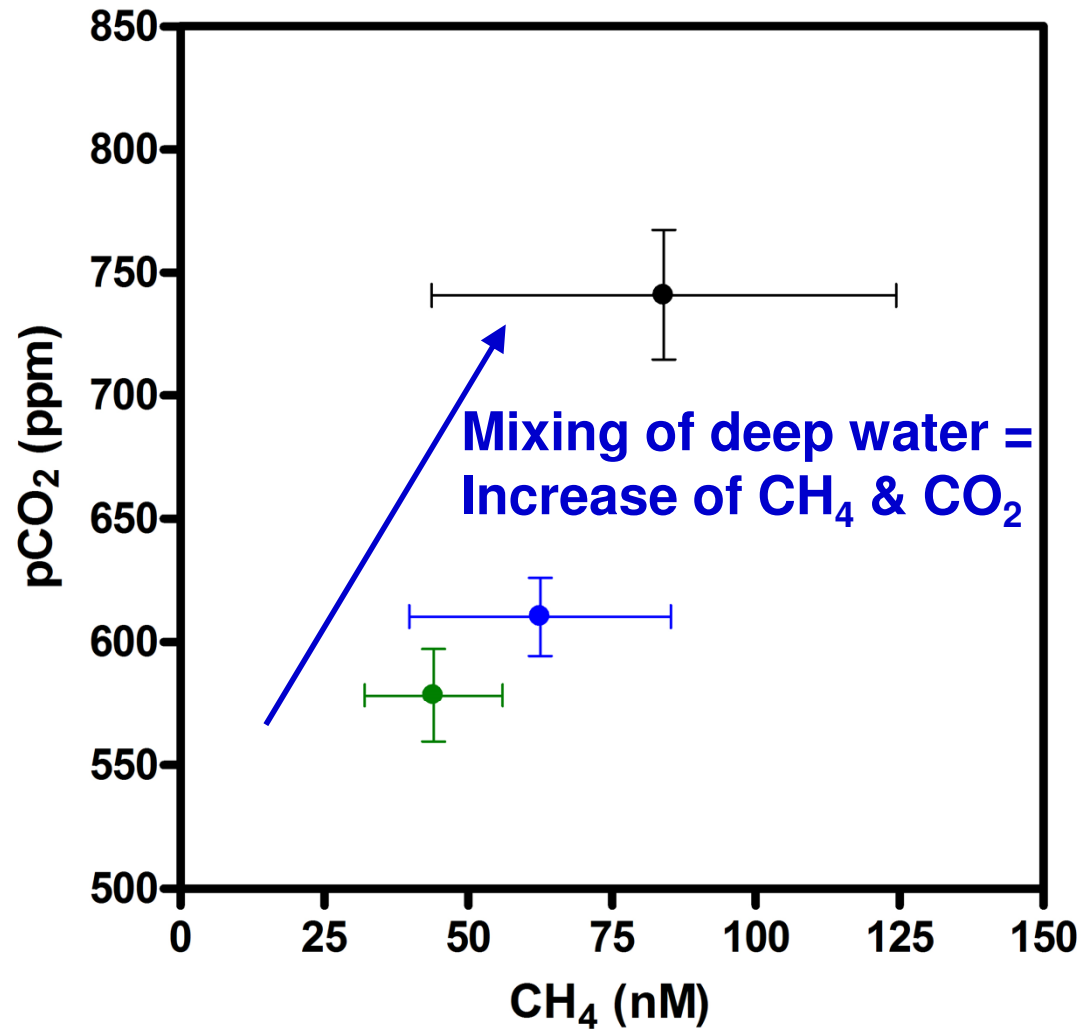


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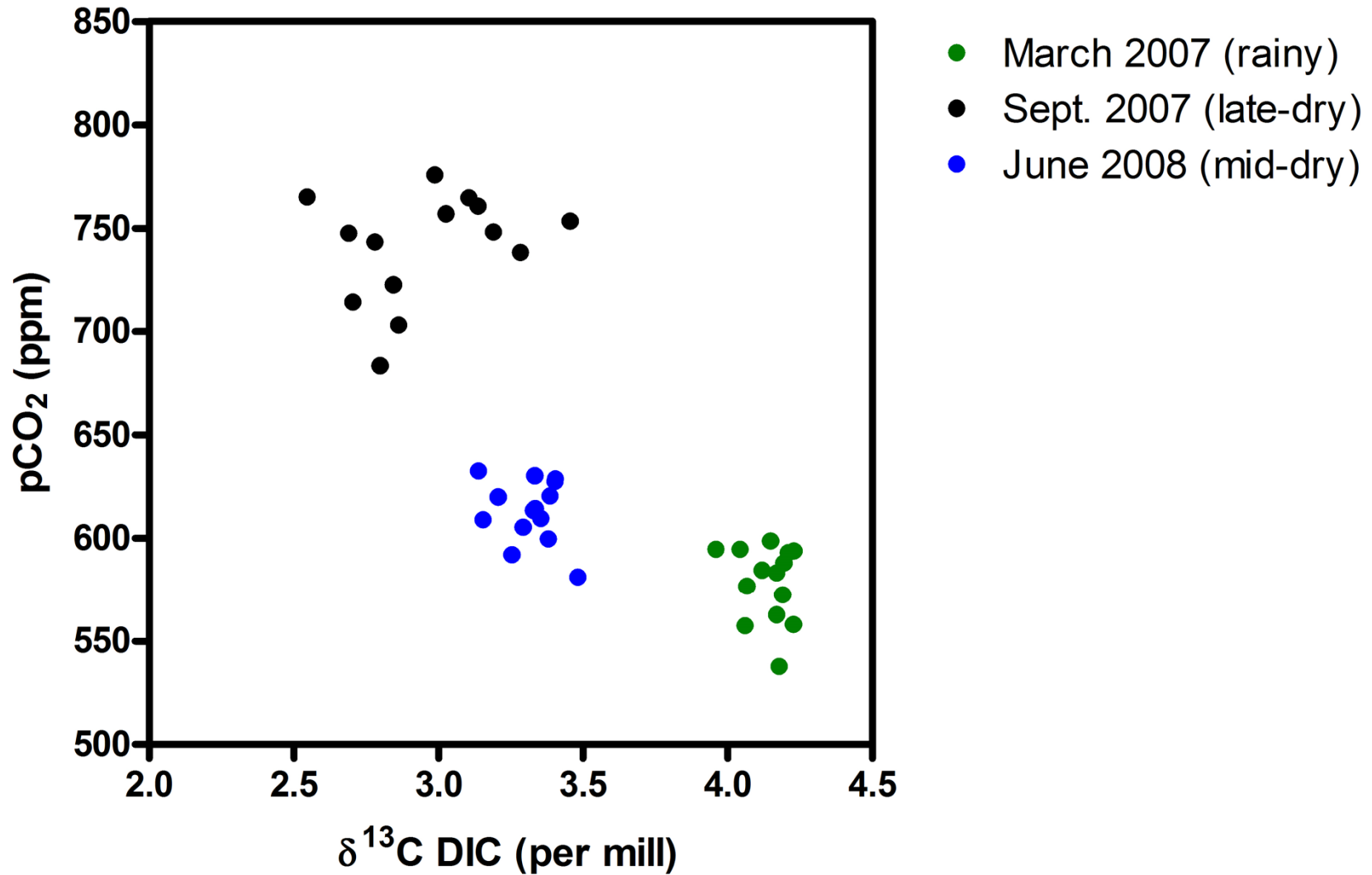
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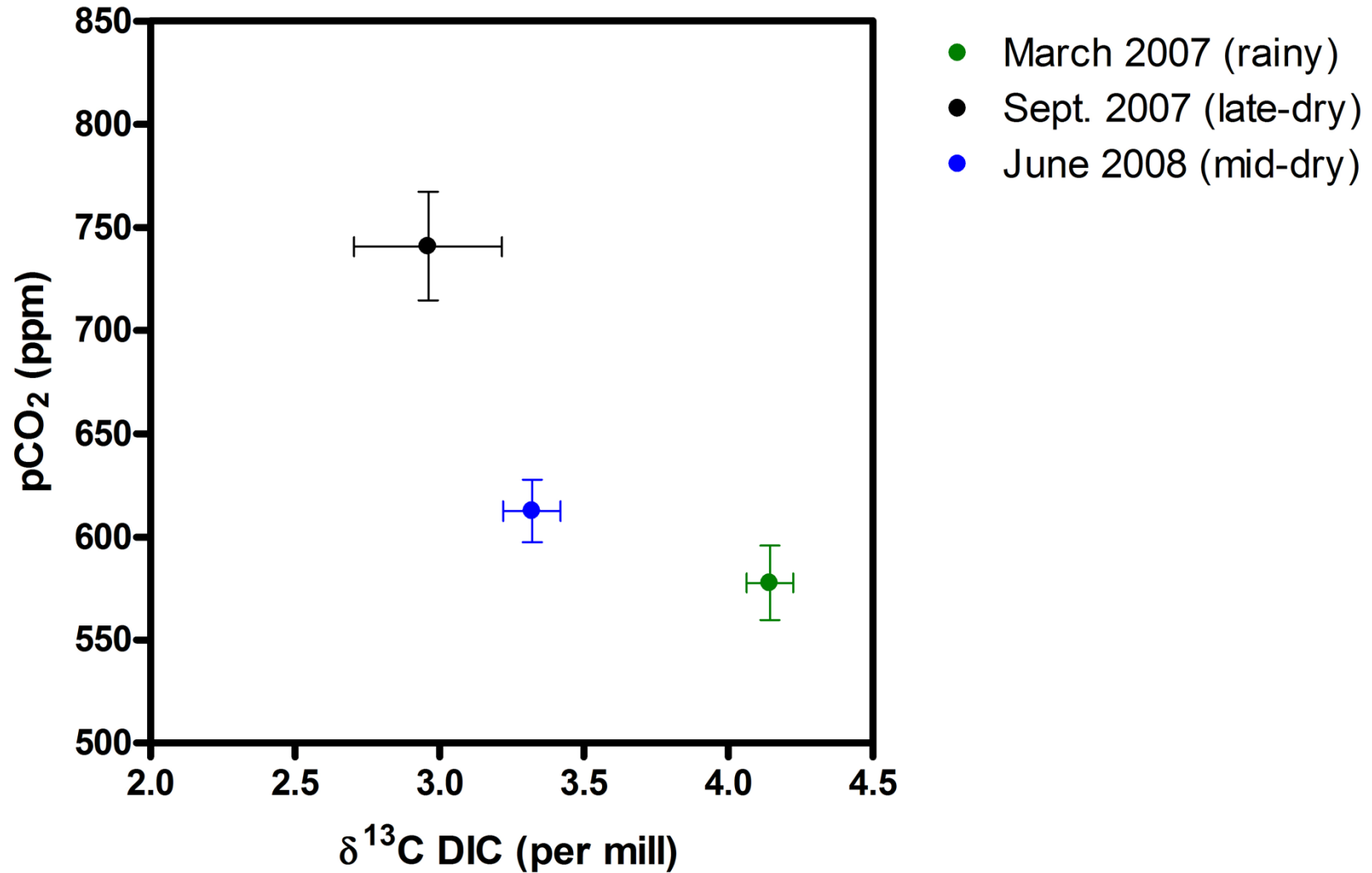


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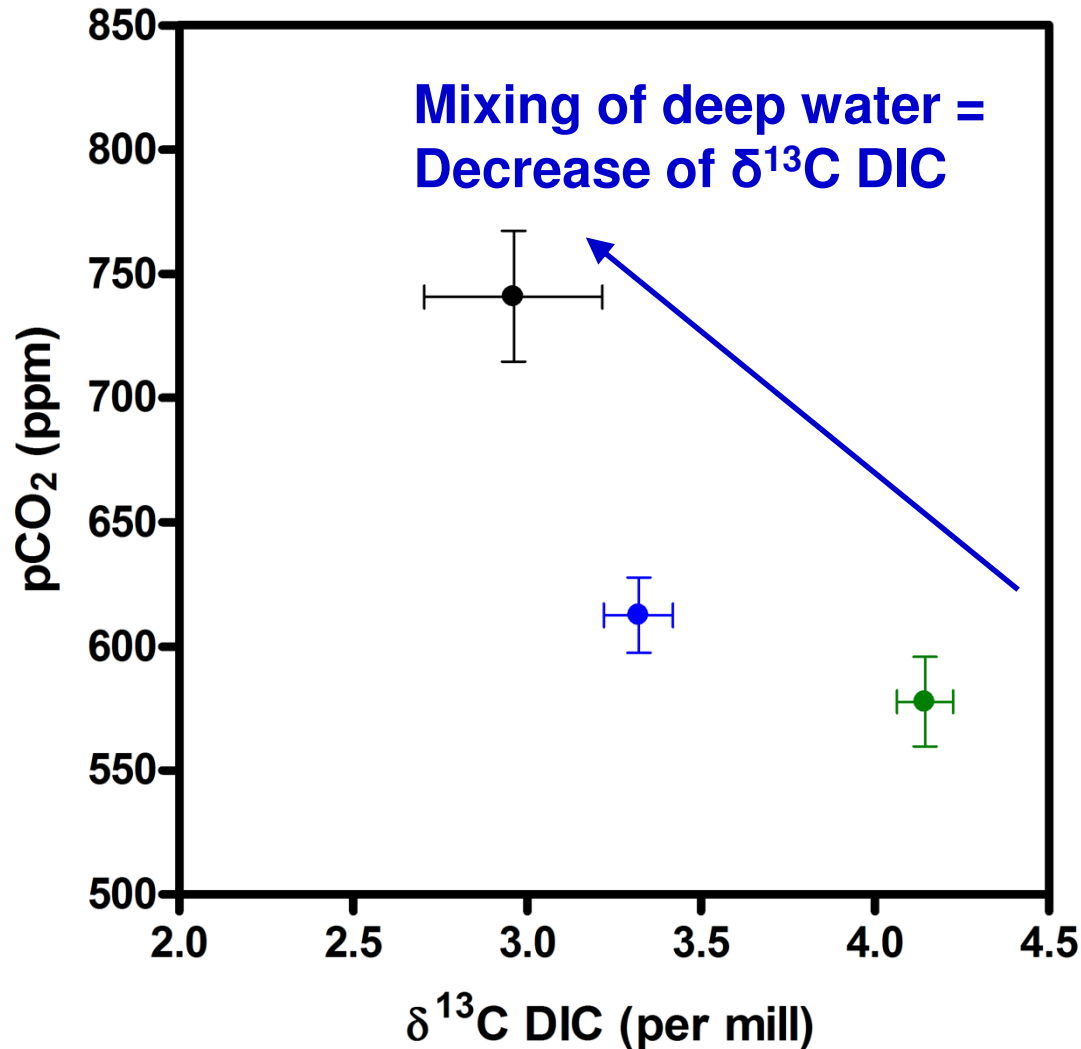
Seasonal variability



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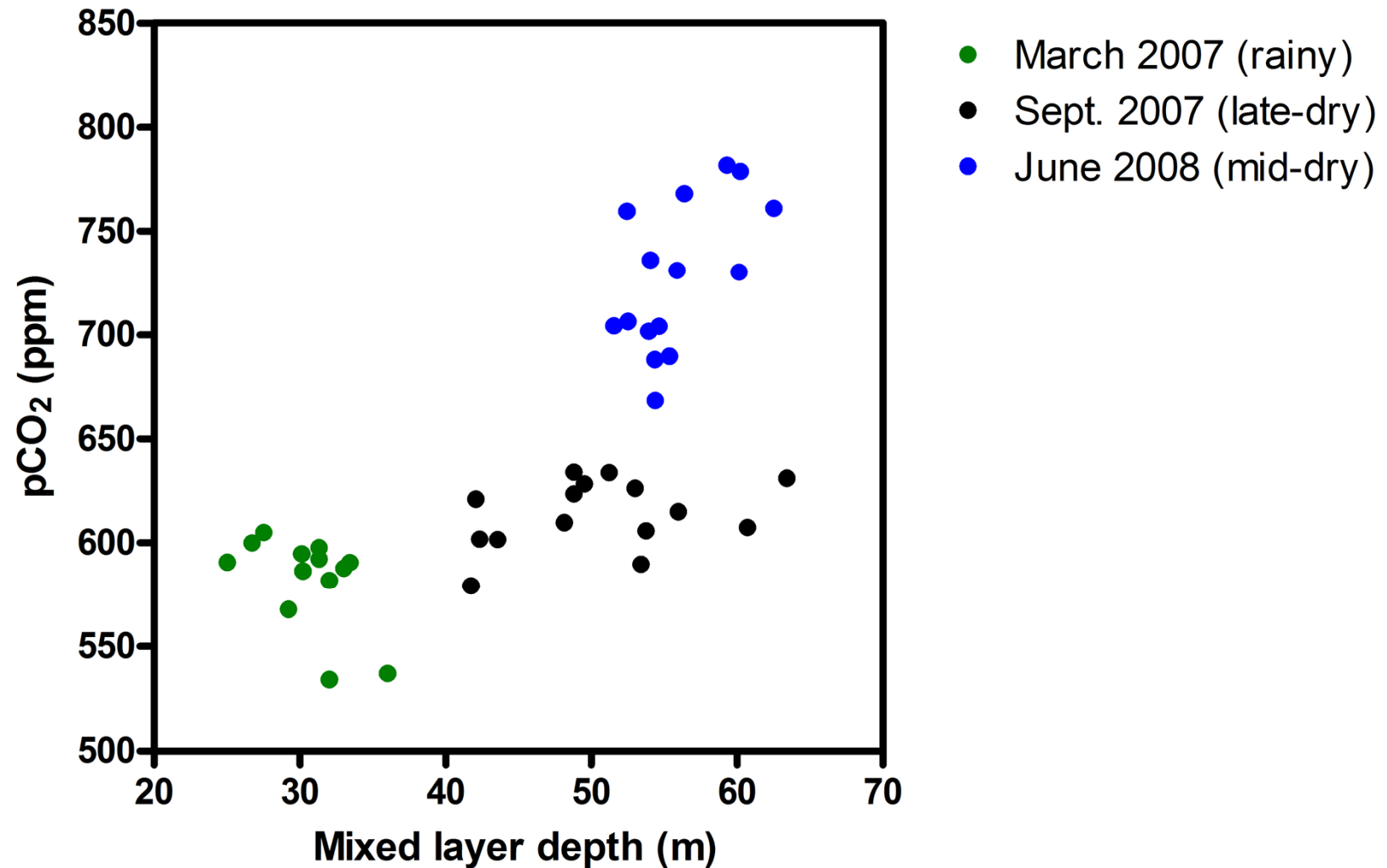


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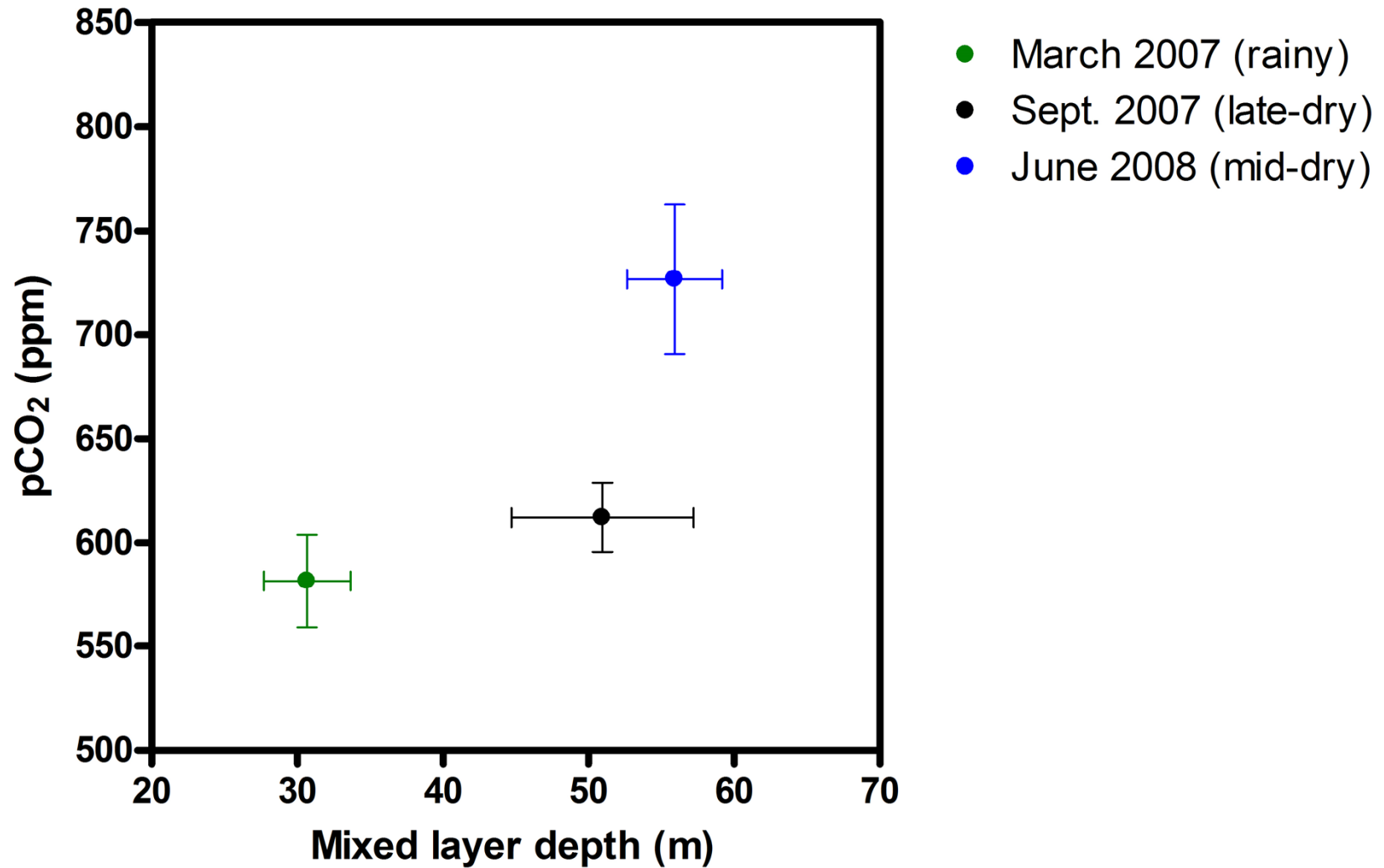


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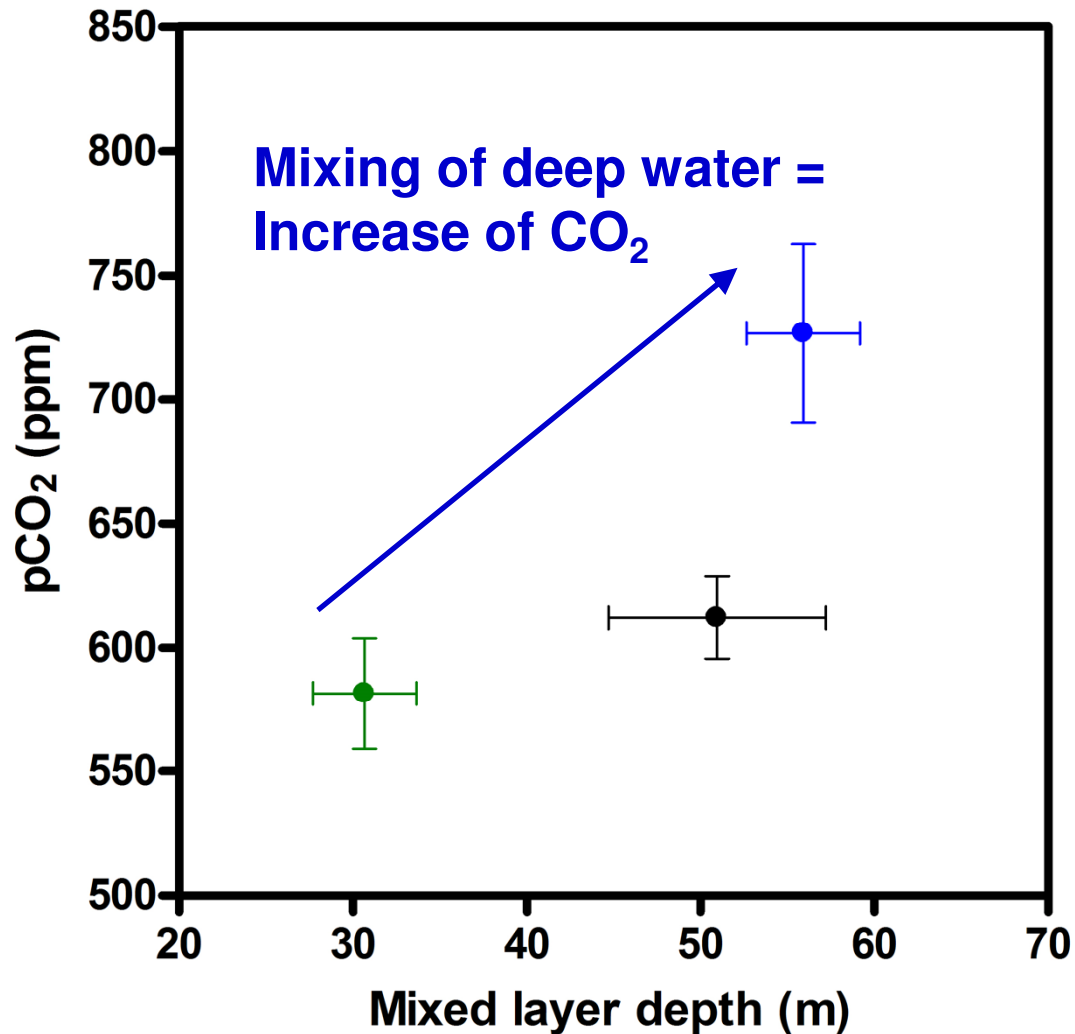
Seasonal variability



Seasonal variability

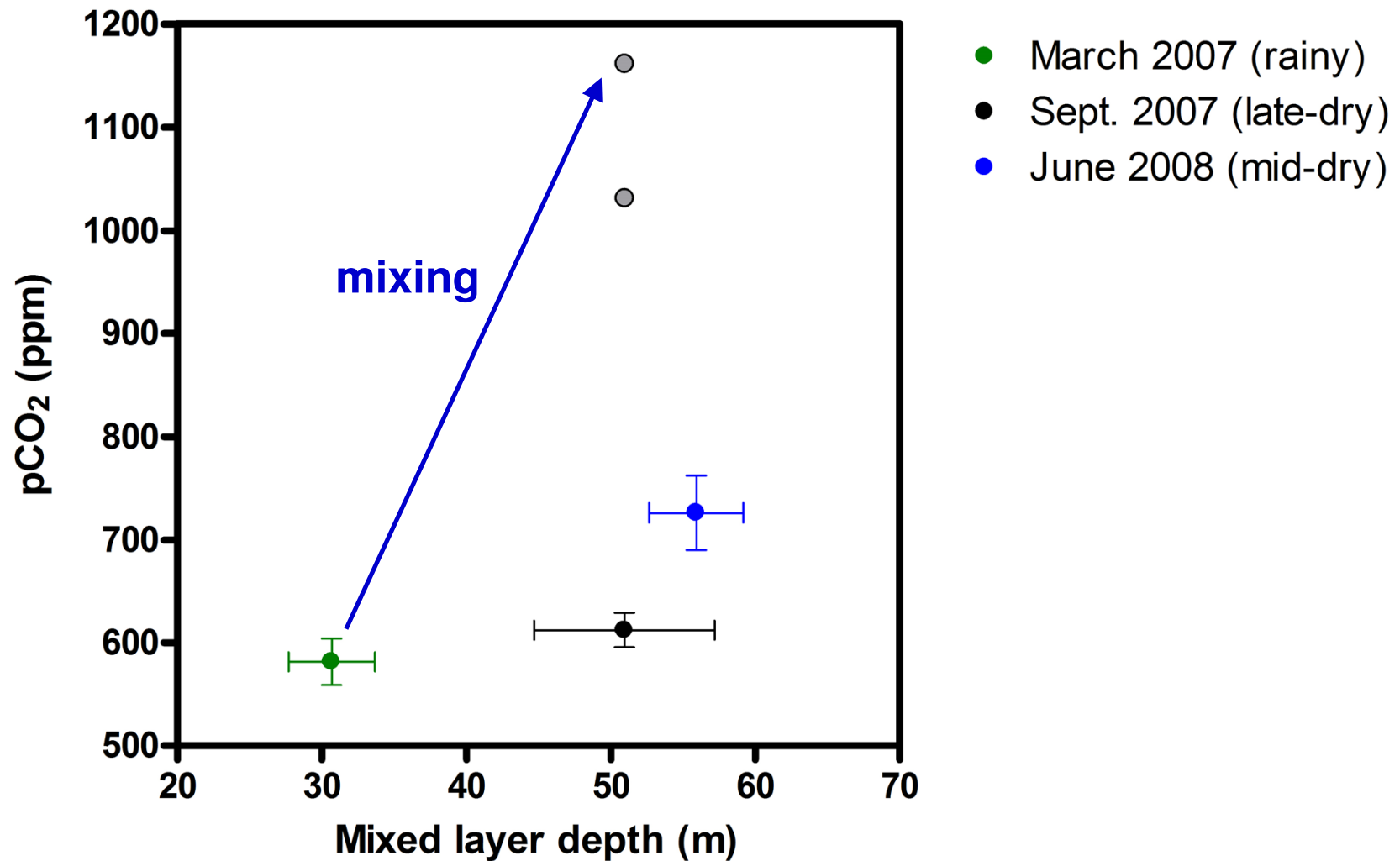


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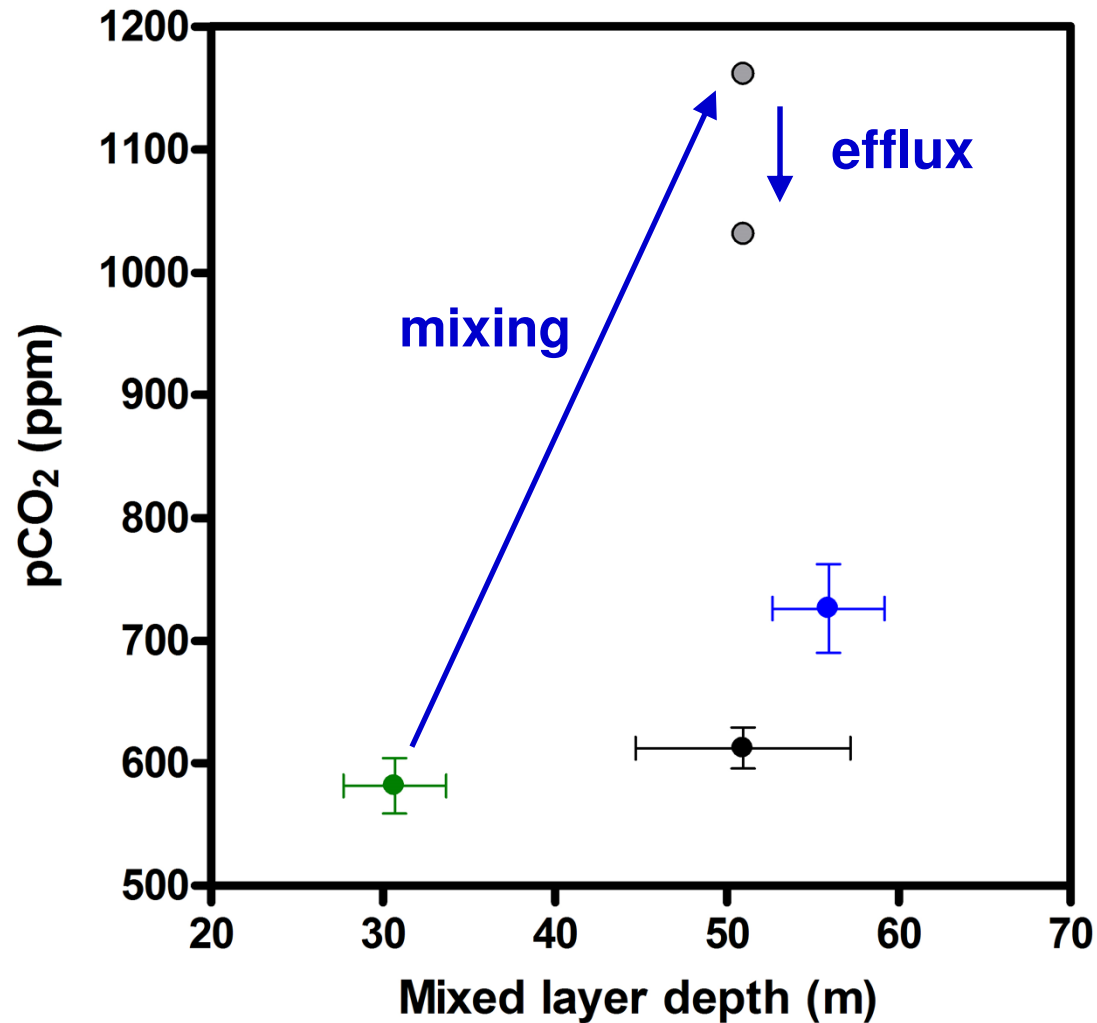


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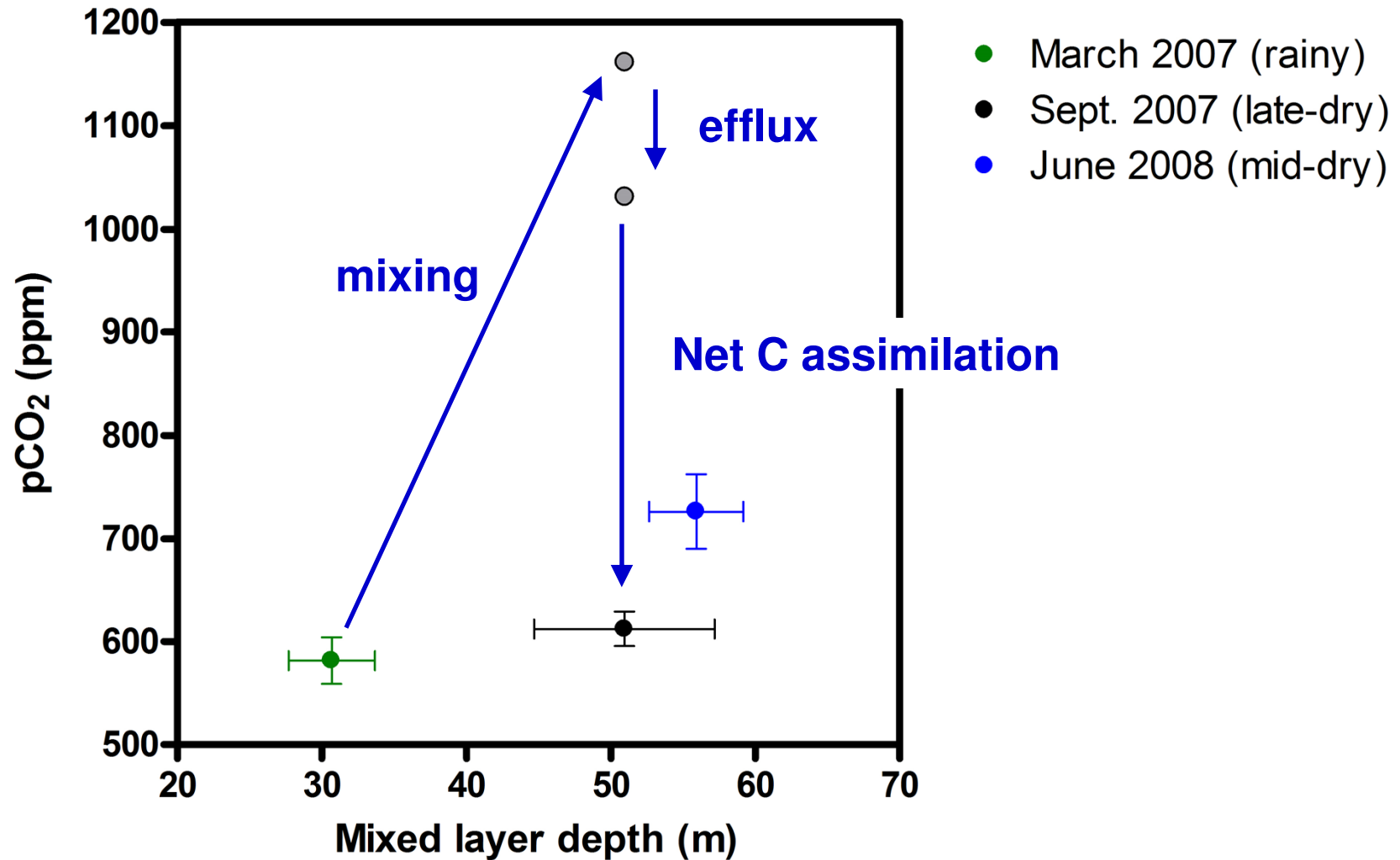


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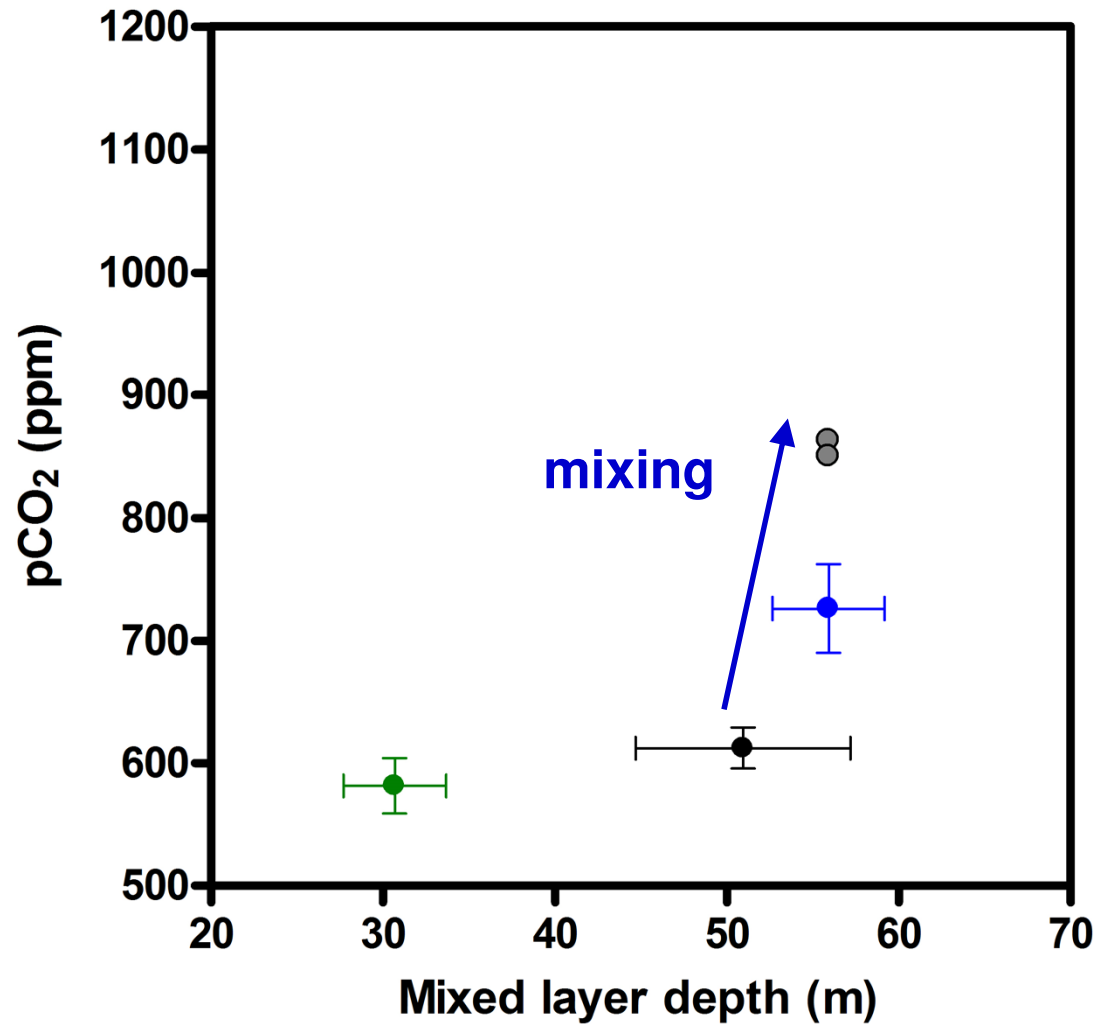


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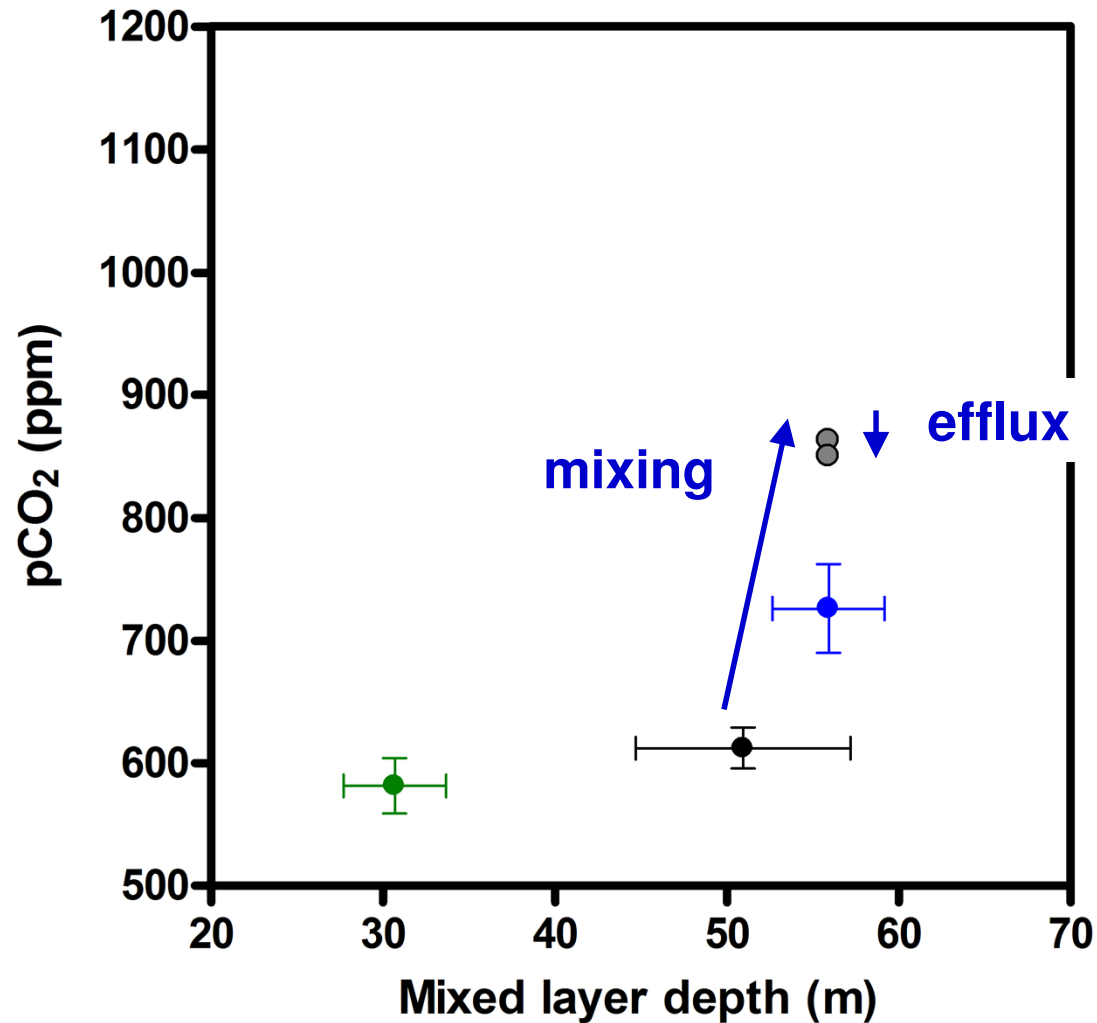


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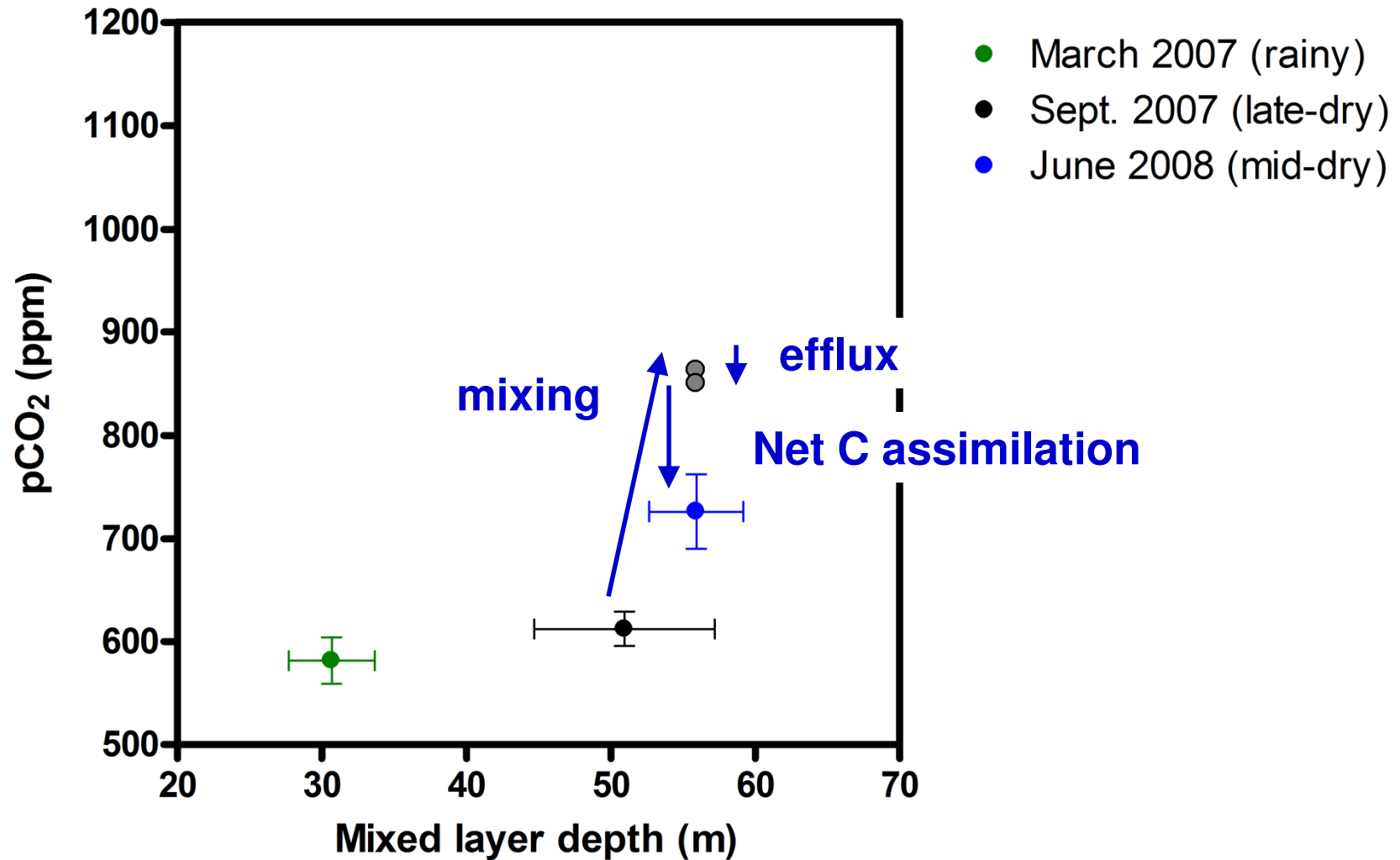
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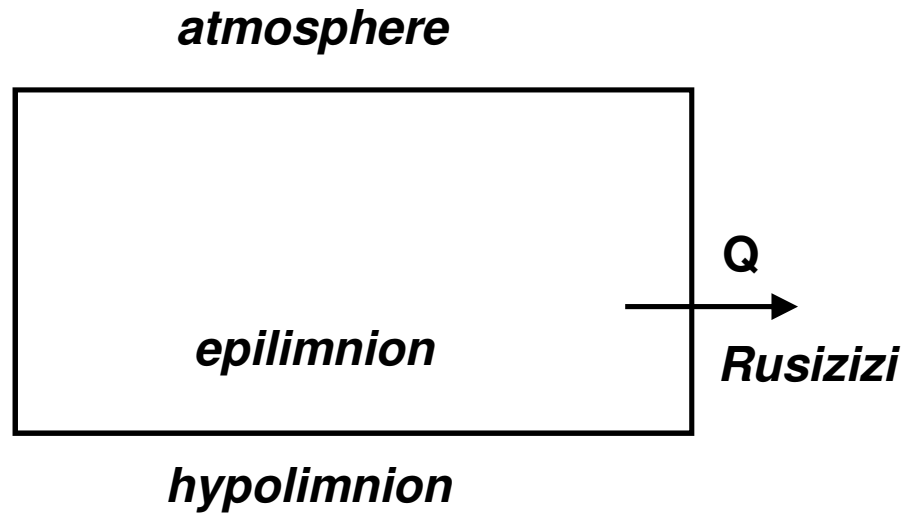
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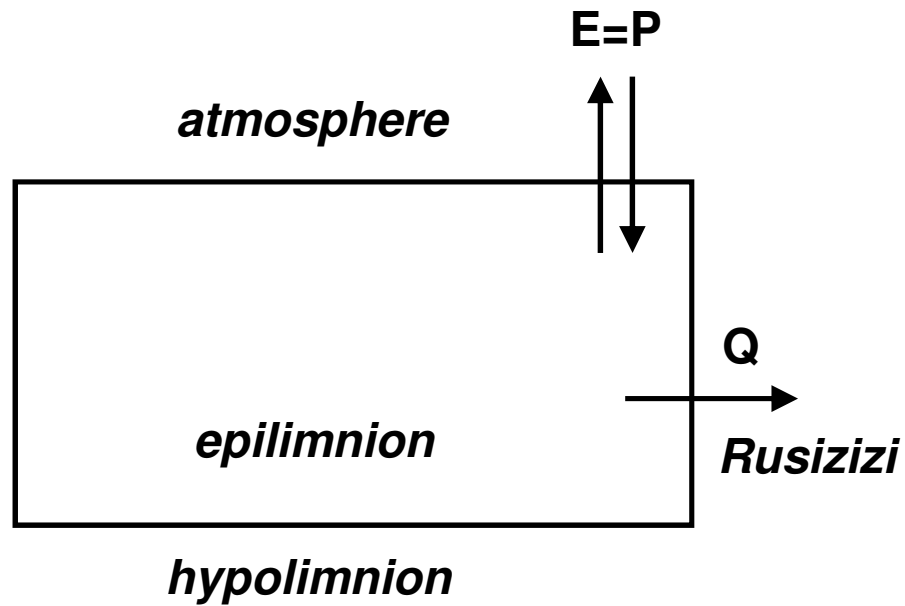
C budget (Sept. 2007)

Salt & water budget

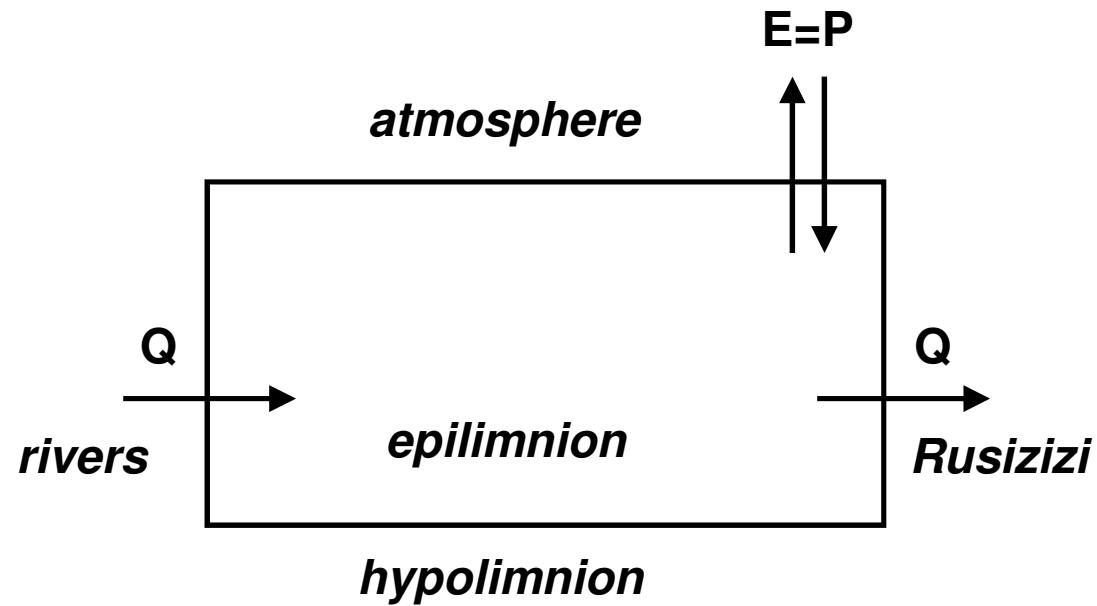


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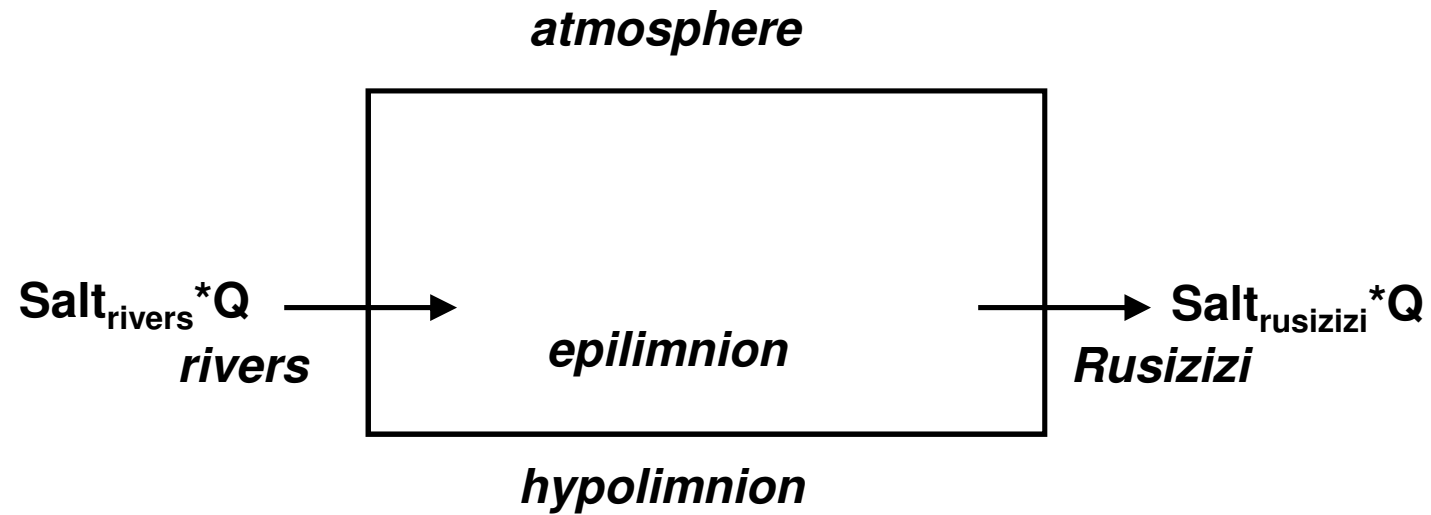


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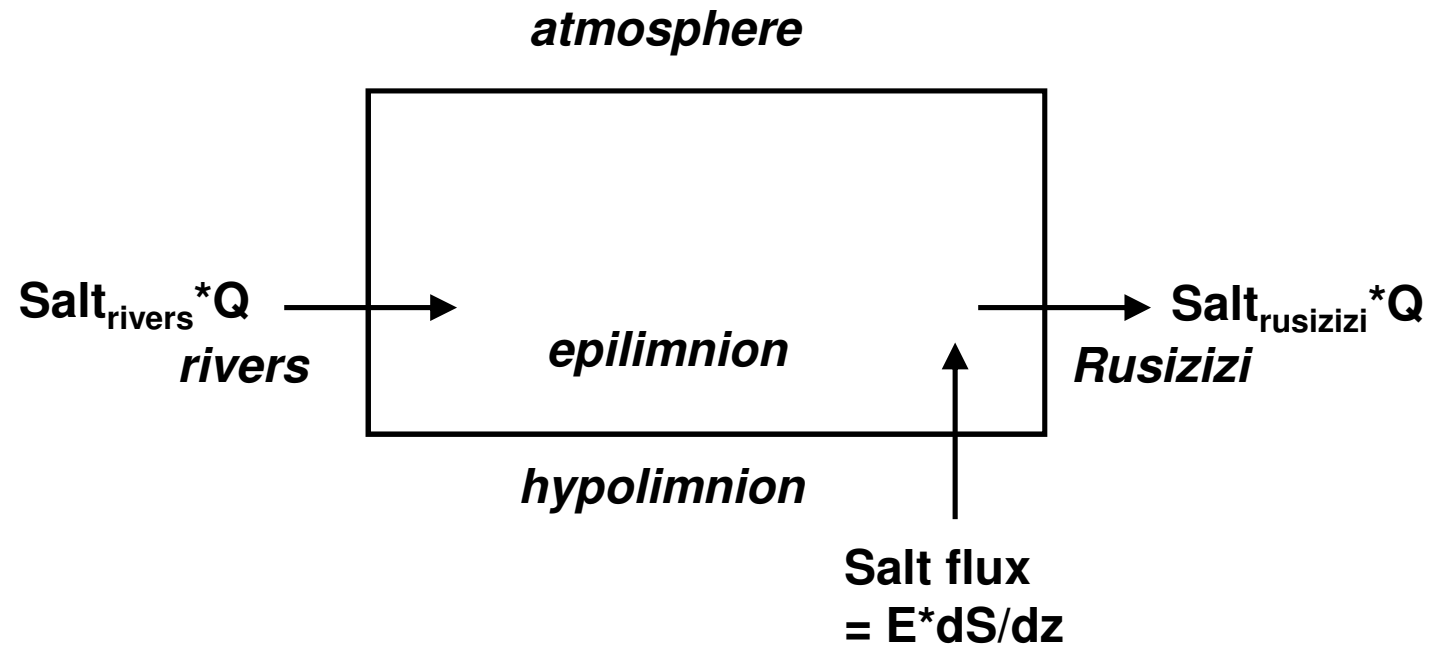
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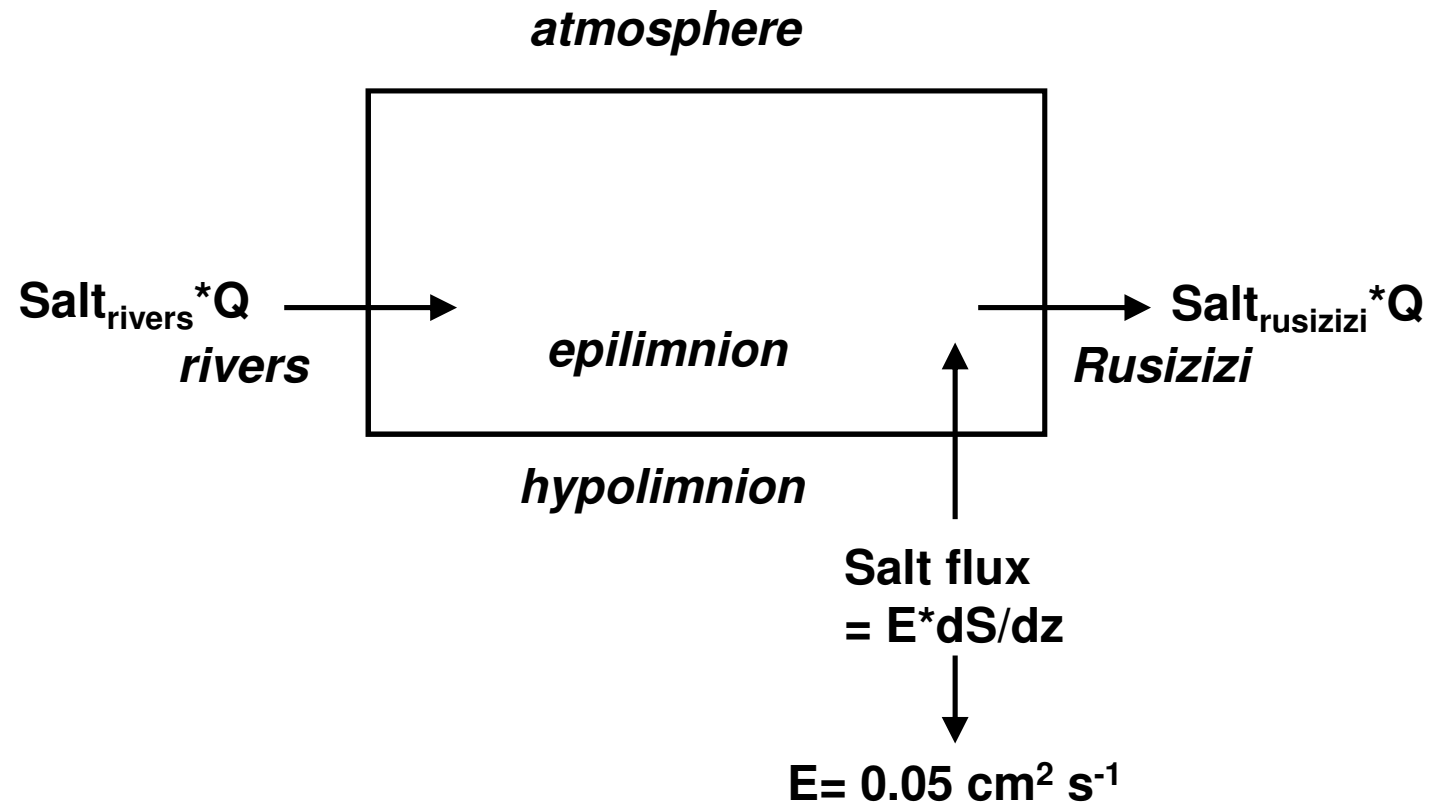
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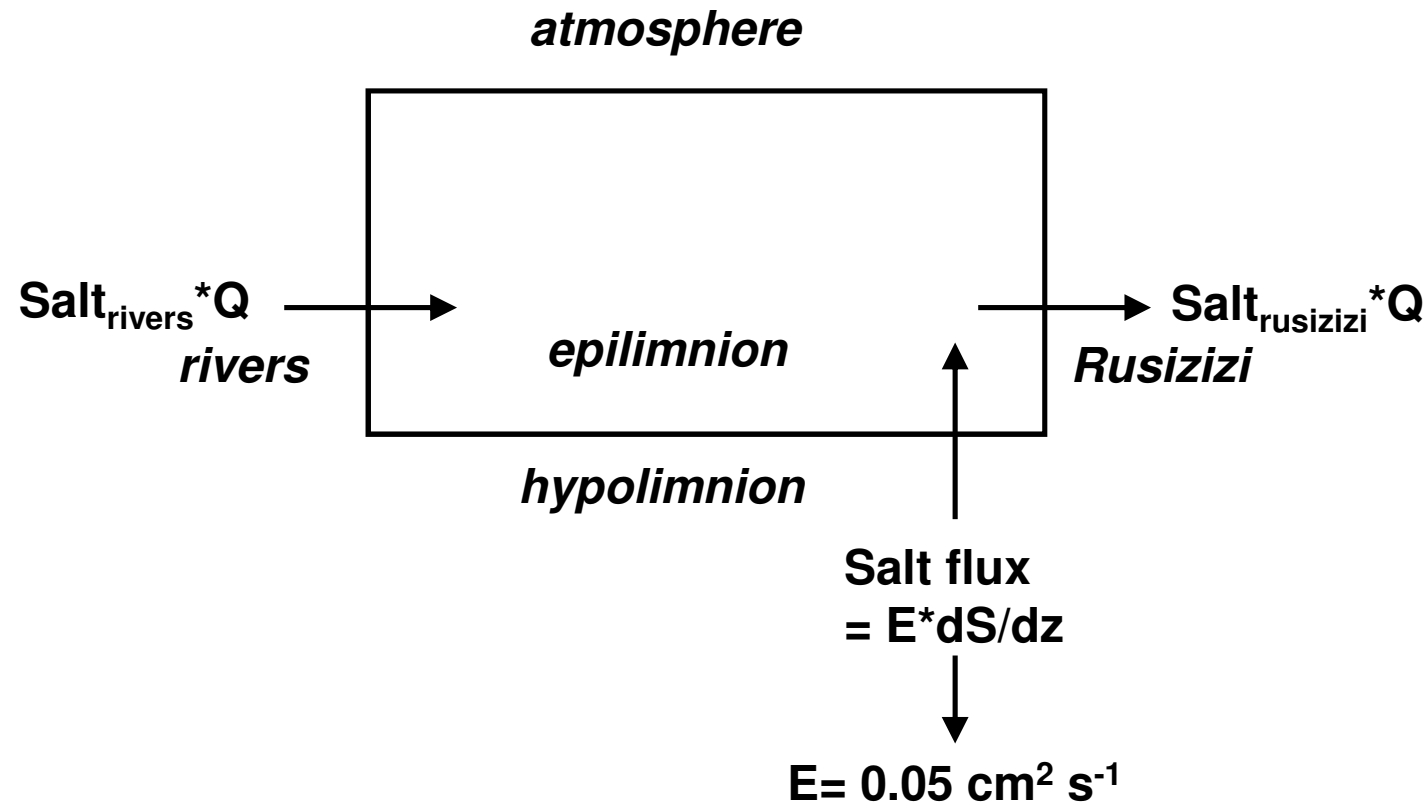


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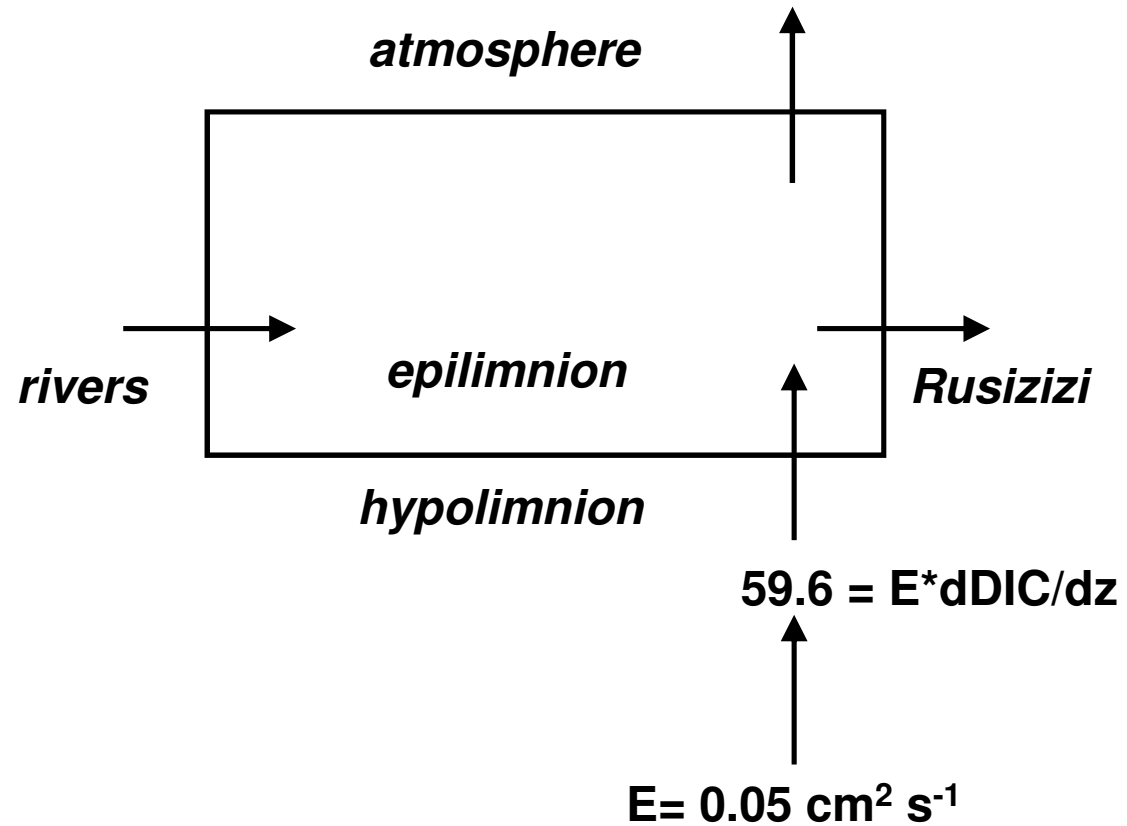
Salt & water budget



Eddy diffusion coefficient (E) in lakes ranges between 0.02 and $0.07 \text{ cm}^2 \text{ s}^{-1}$
Sweers (1970) *Limnology and Oceanography*, 15(2), 273-280.

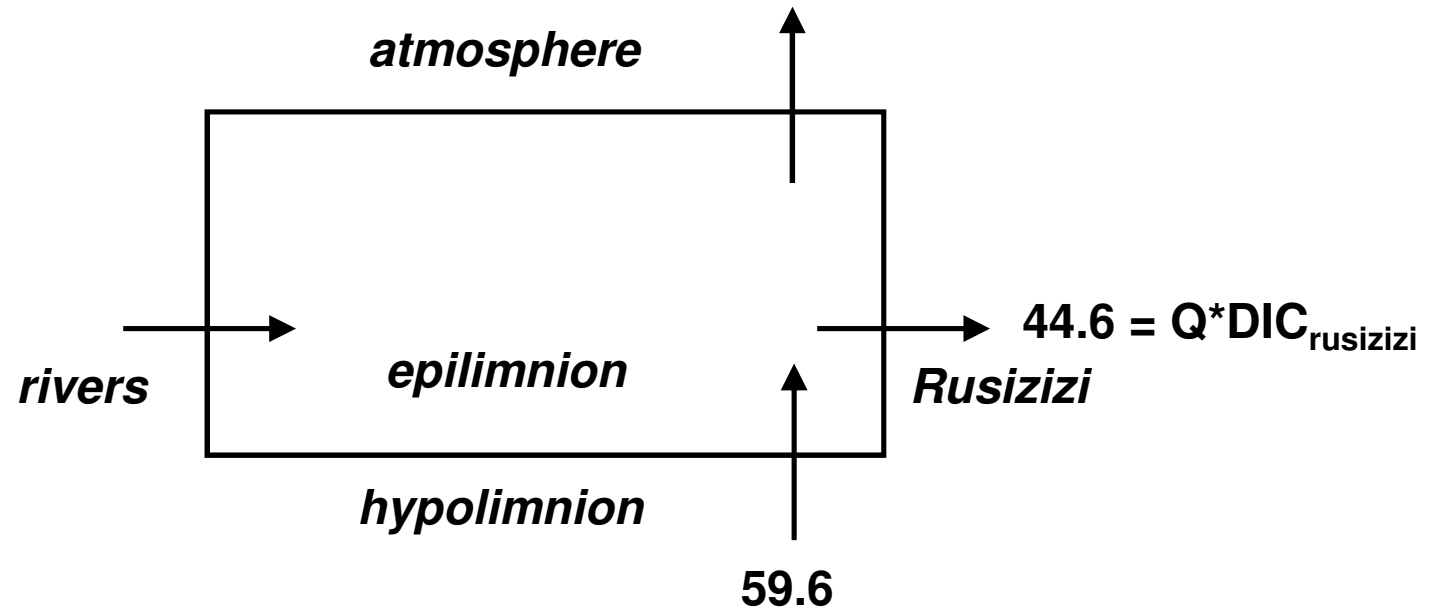
C budget (Sept. 2007)

DIC budget ($\text{mmolC m}^{-2} \text{d}^{-1}$)



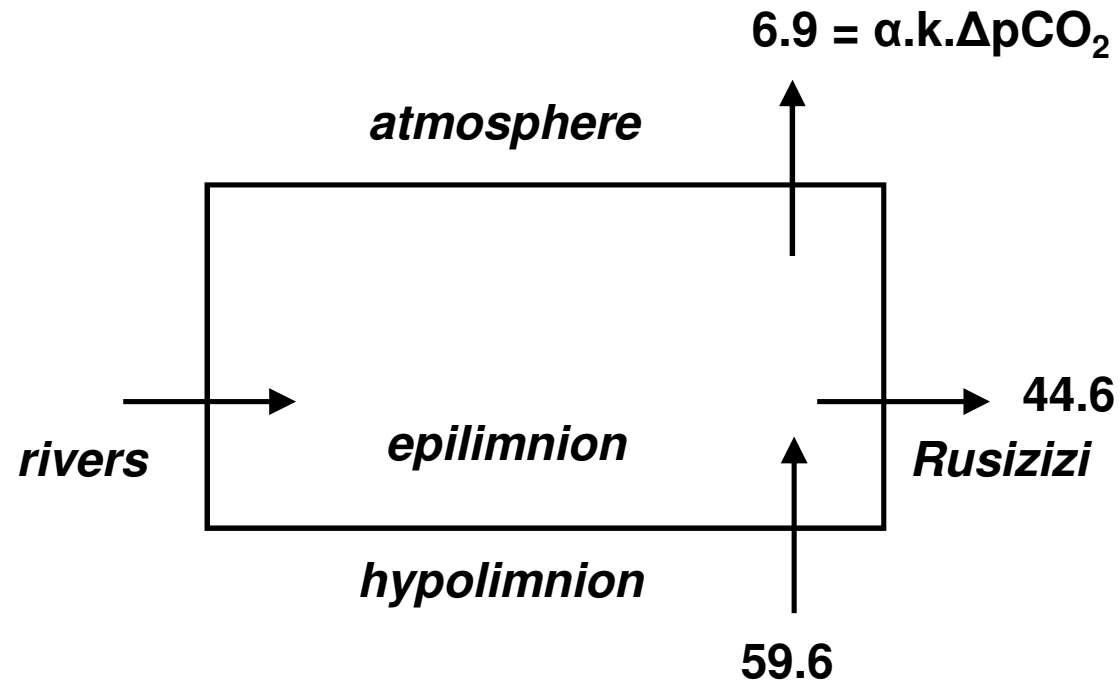
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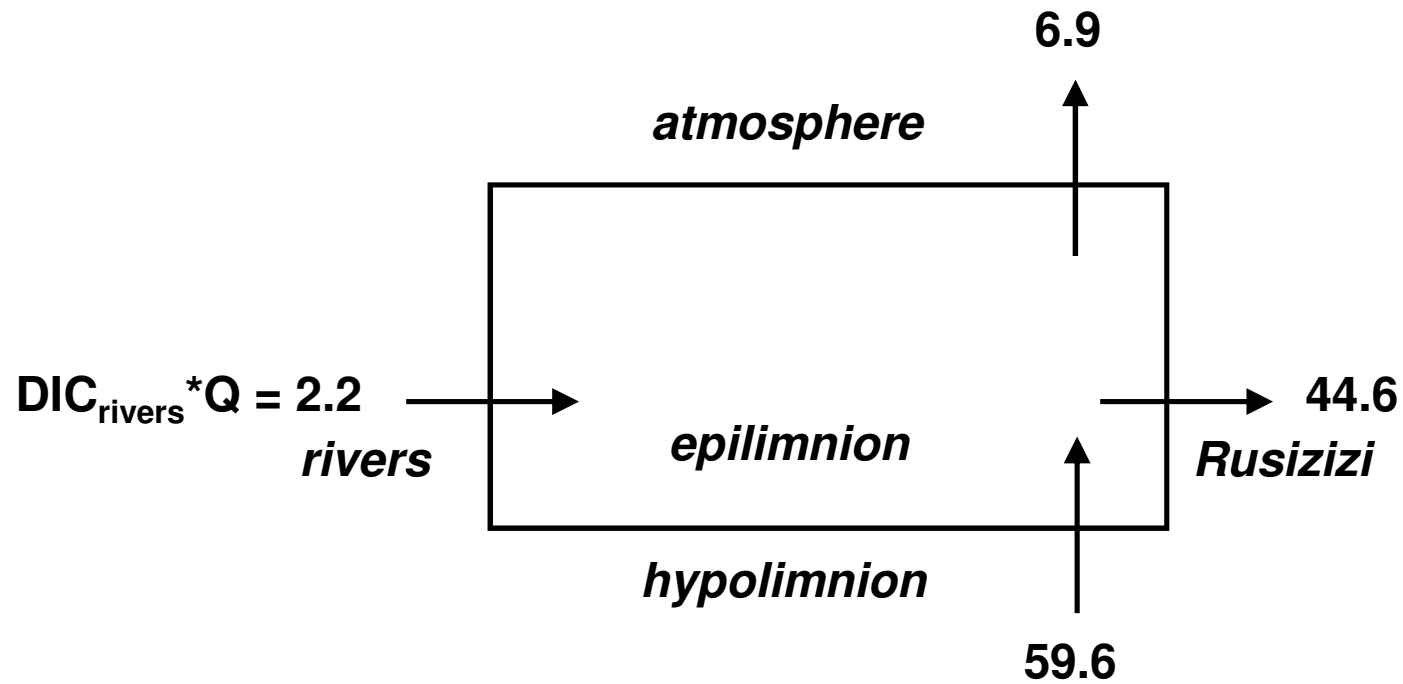
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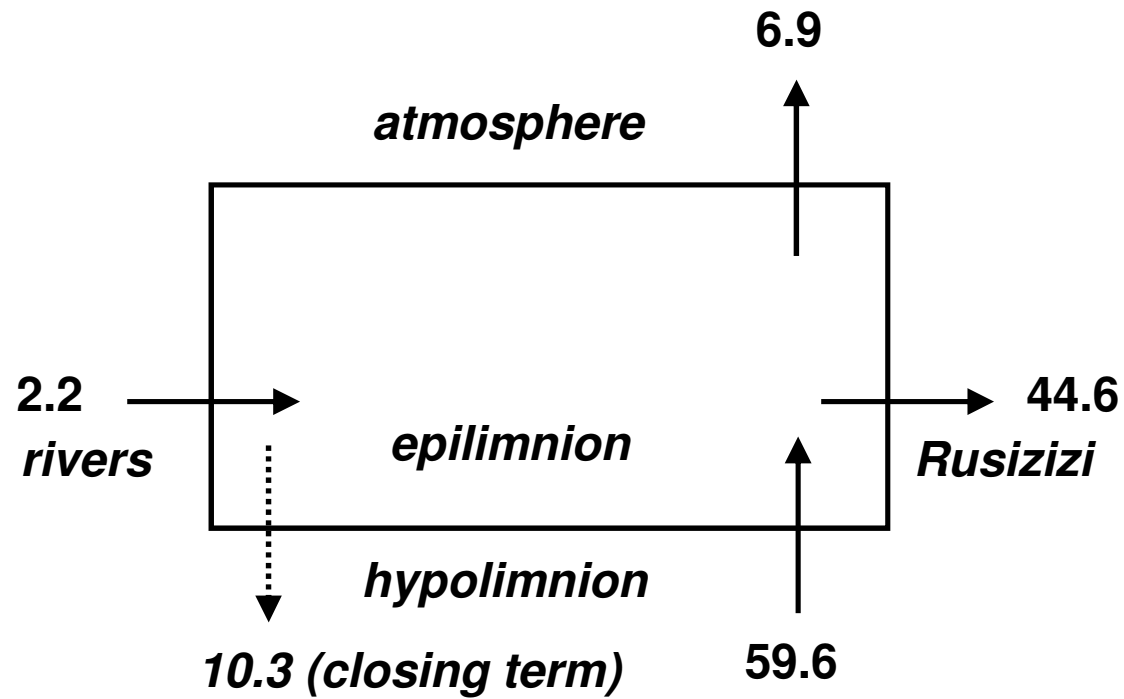
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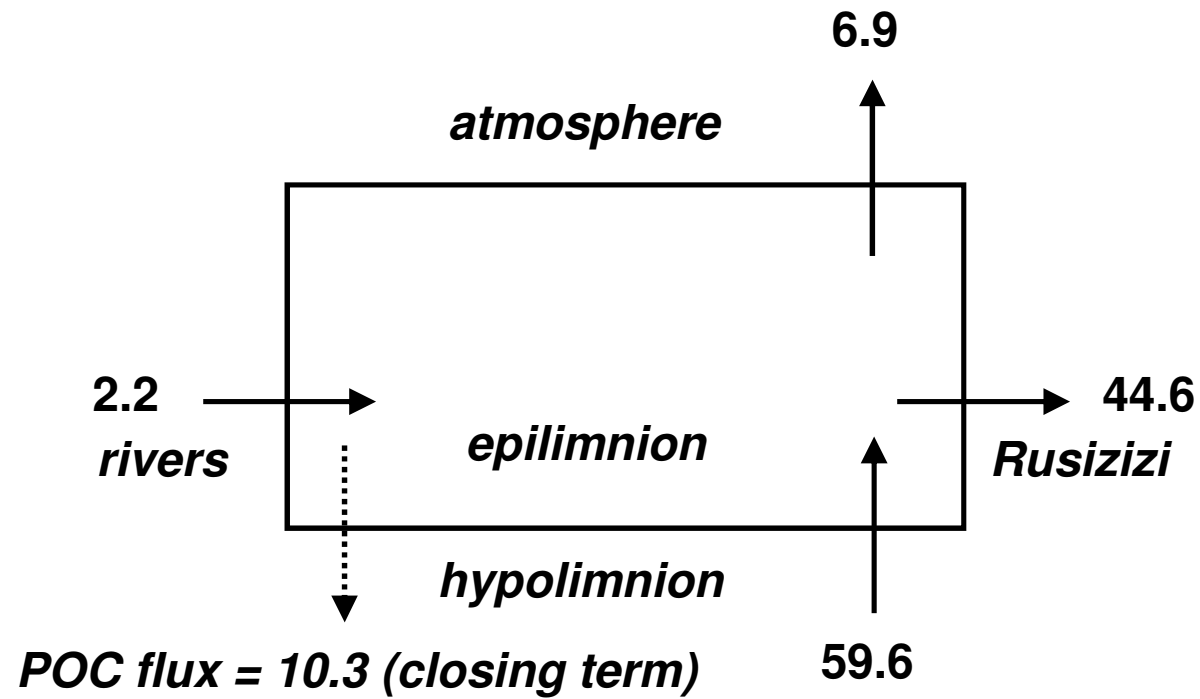
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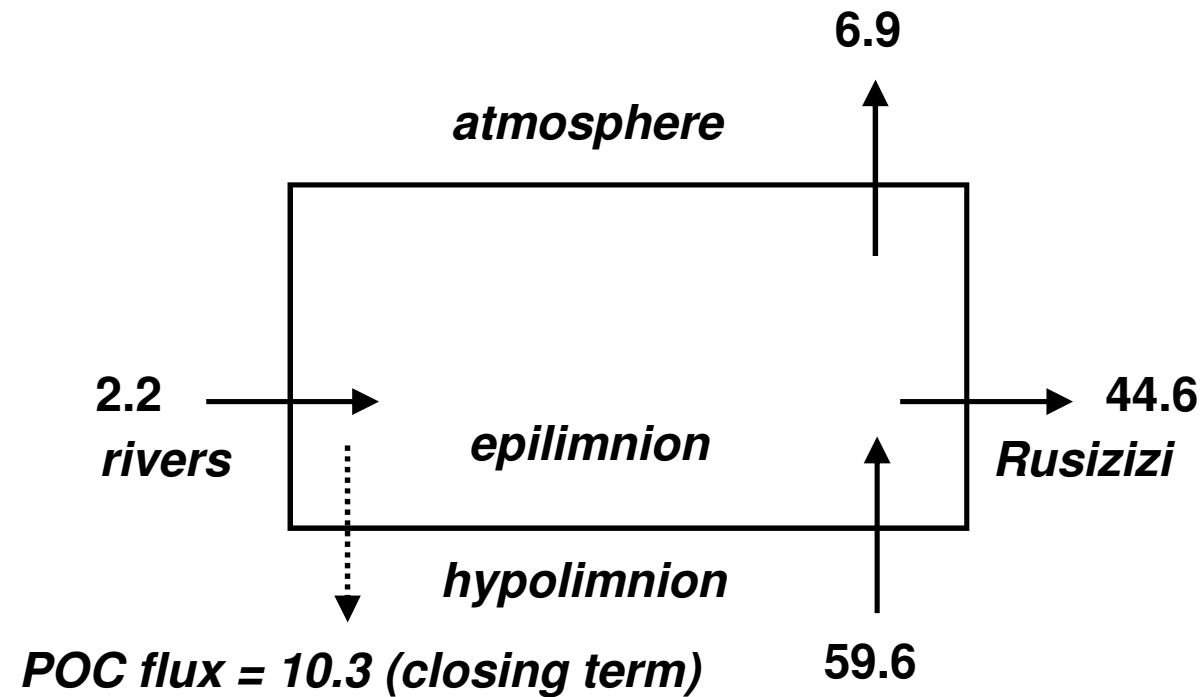
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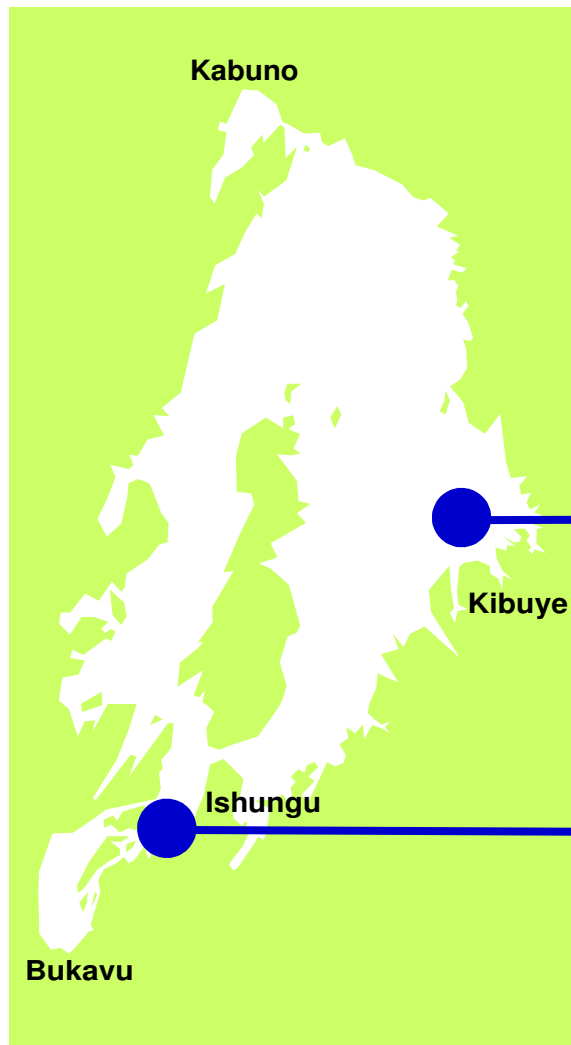
C budget (Sept. 2007)

DIC budget ($\text{mmolC m}^{-2} \text{d}^{-1}$)



9.8 $\text{mmolC m}^{-2} \text{d}^{-1}$ derived from sediment trap data (EAWAG) !

C budget (Sept. 2007)

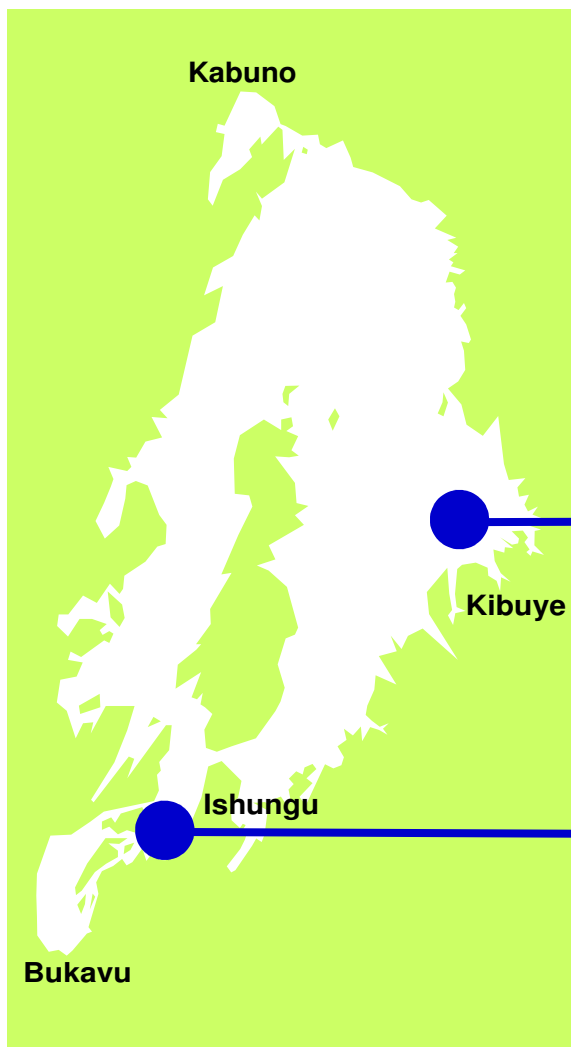


mmolC m⁻² d⁻¹

	NPP	BP	BR	NPP/BR
March 2007	53	25	112	0.47
Sept. 2007	43	34	119	0.36
June 2008	47	8	88	0.53

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March 2007	46	46	127	0.36
Sept. 2007	-	71	142	-
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- Large dissolved primary production to sustain BR
- Epilimnion = net autotrophic system
- Epilimnion = source of CO₂ to the atmosphere
- Role of deep geothermal CO₂ inputs.

Next :

- F.R.F.C. CAKI will continue until 2010**
- Mooring of O₂ (ULg), Chla & phicoerythrine (FUNDP) & POC/PIC sediment traps (start in April-May 2009)**
- Role of CH₄ to sustain microbial loop**
- Constrain dissolved primary production**

“Beyond next”:

Sustained sampling at Belspo and/or EU level is required to estimate the impact of industrial extraction of CH₄ on C cycling (& emission of CO₂ & CH₄ to the atmosphere) & ecological functioning of the lake.

We are in a good position to achieve this since we have “base-line” (large) chemical & biological data-set, and high temporal resolution data from the mooring.

