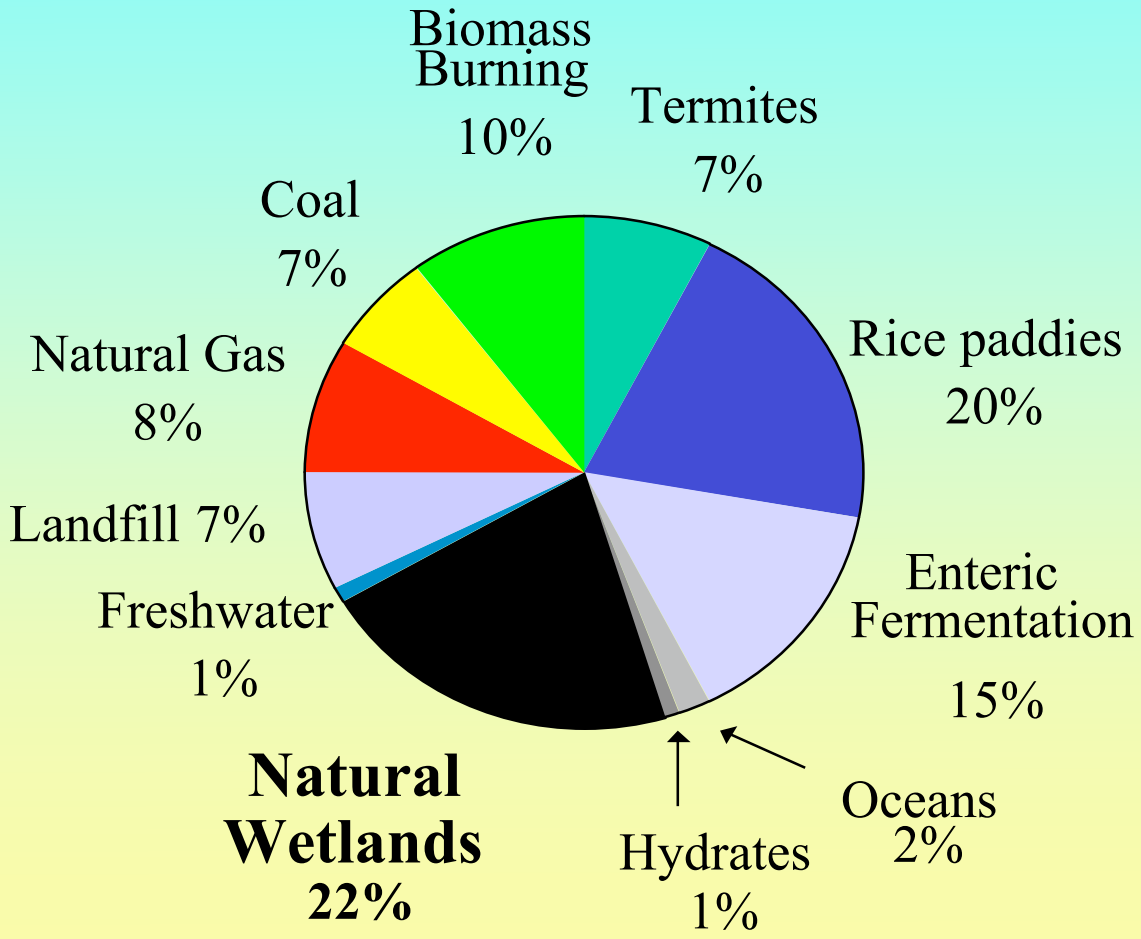
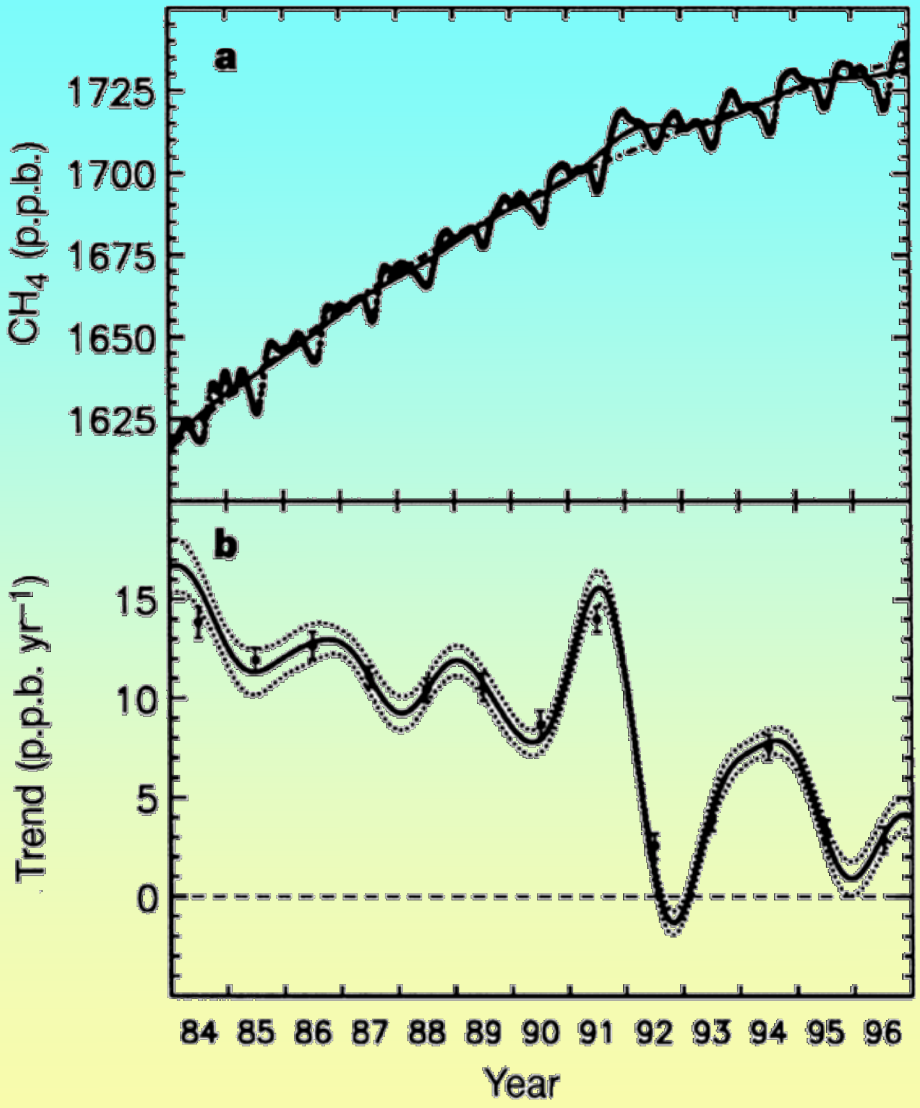
Acid Rain Links to Methane Emissions from Wetlands

Vincent Gauci

The Global Methane Budget





Atmospheric Methane Growth Rate

Dlugokencky *et al* 1998

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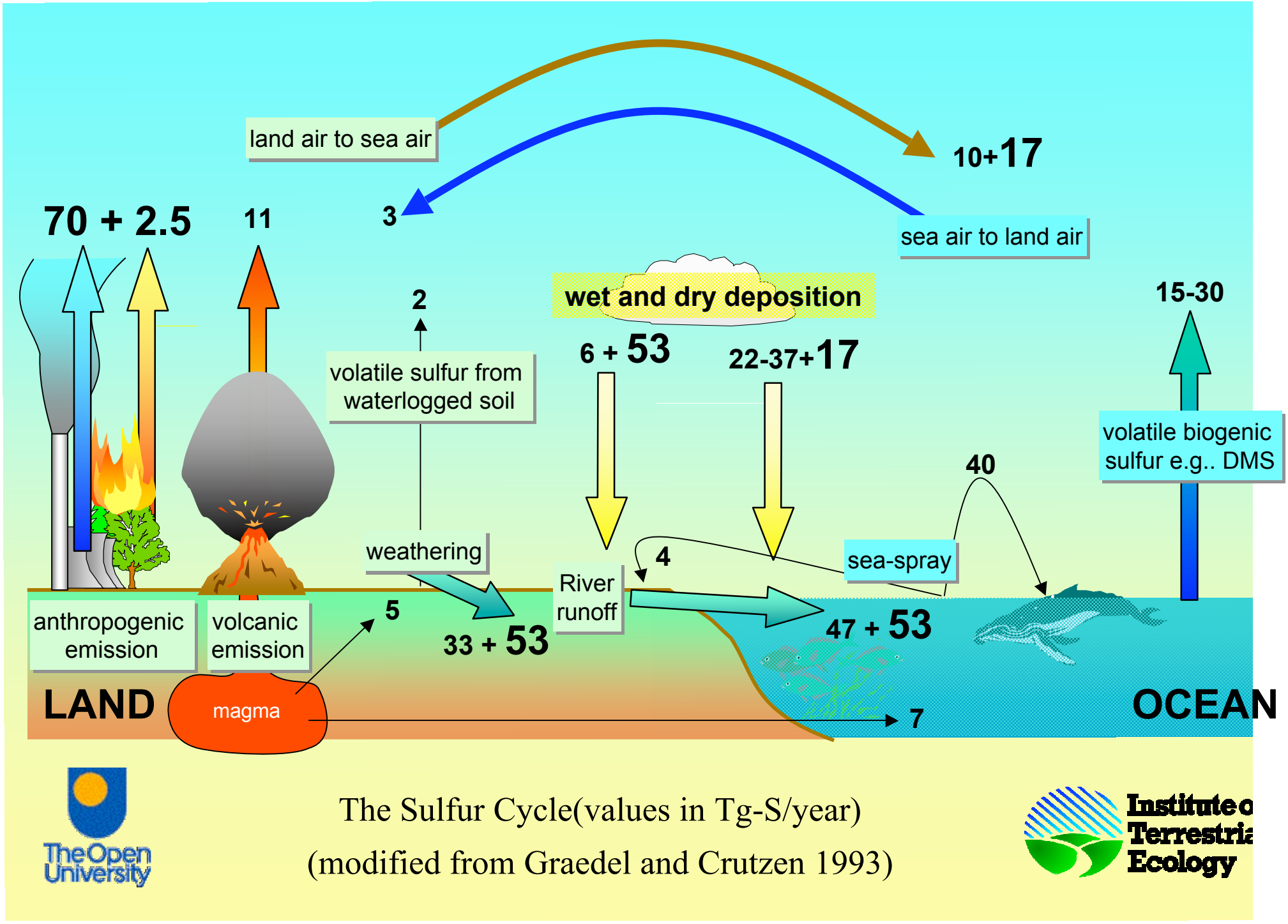
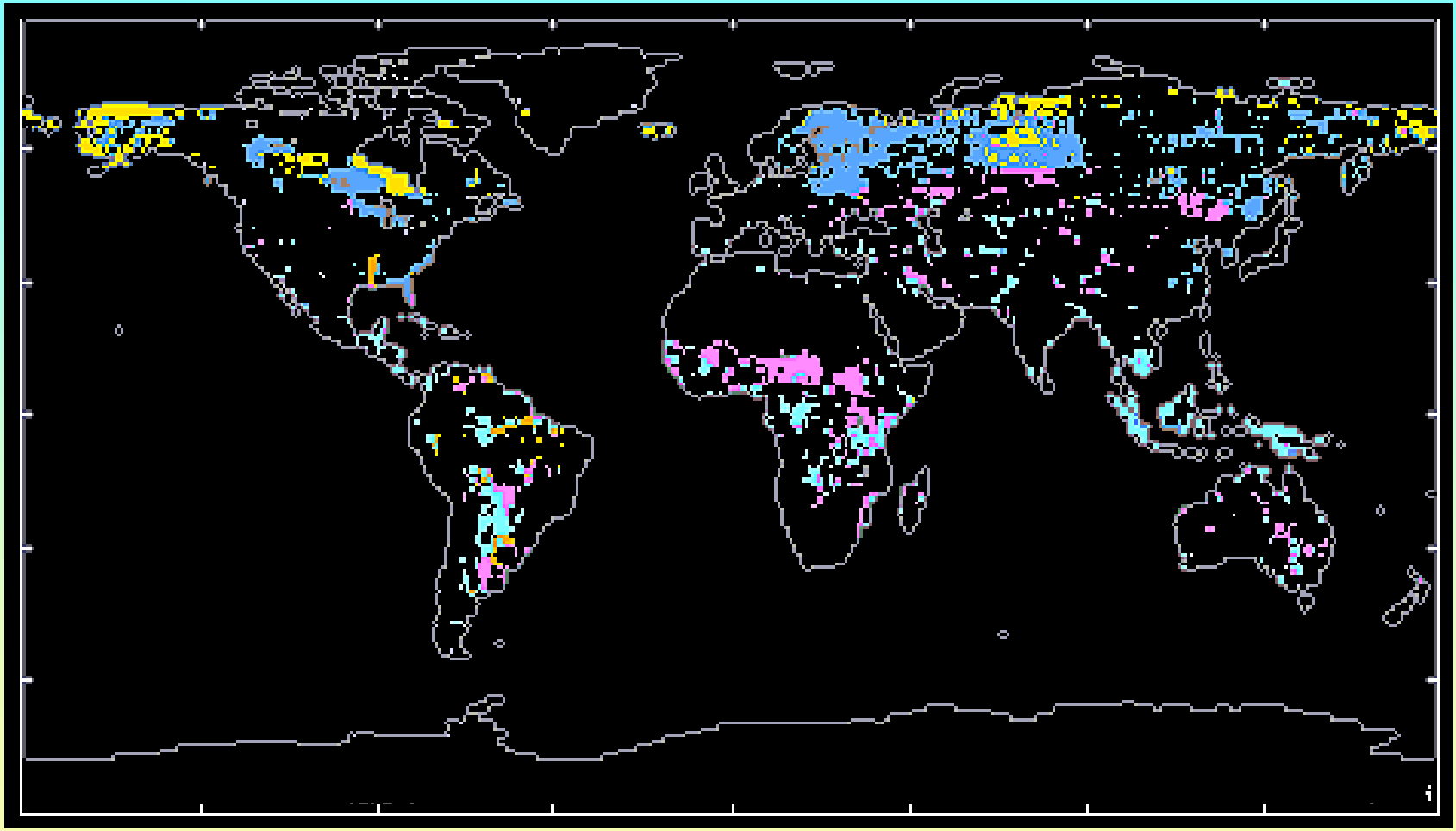


The Sulfur Cycle(values in Tg-S/year)

(modified from Graedel and Crutzen 1993)

Distribution of Wetland Ecosystems

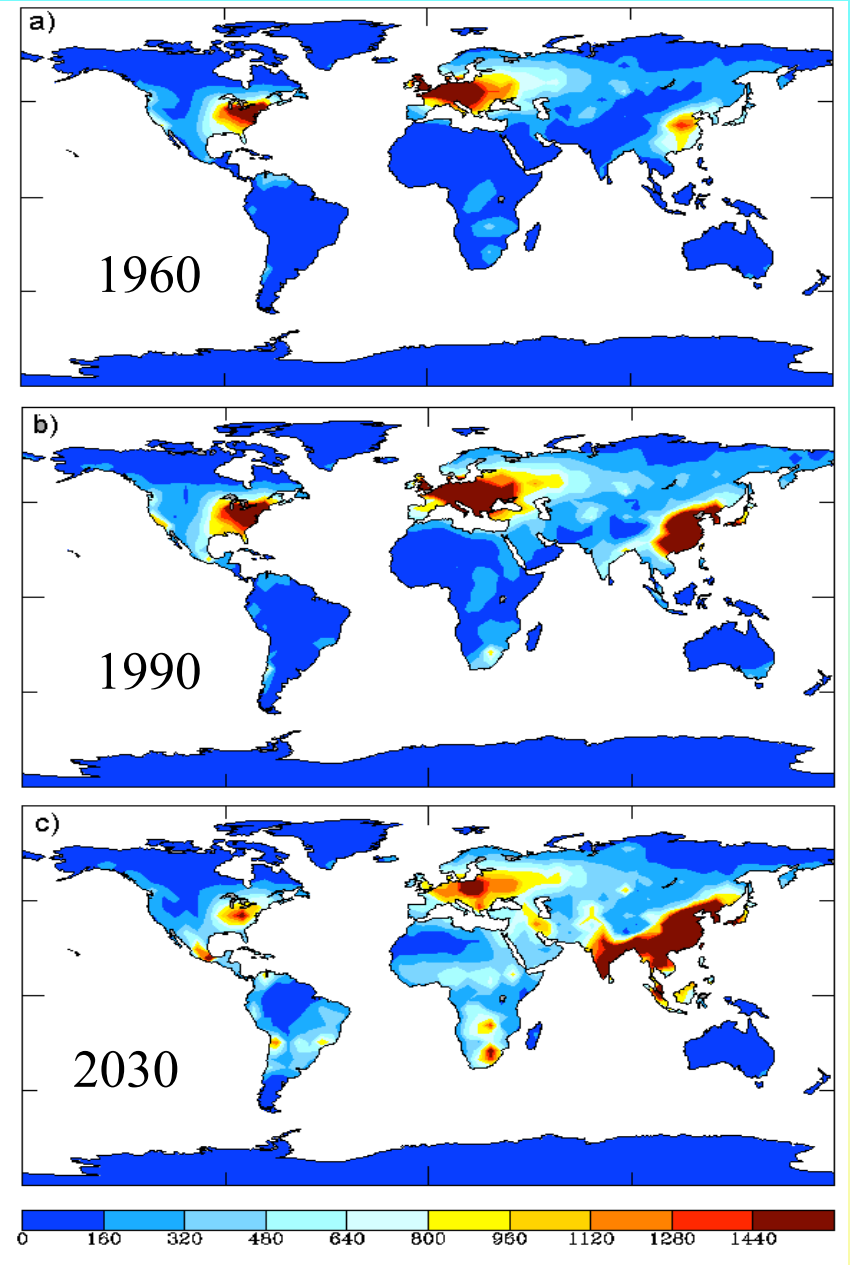


E. Mathews and I. Fung (1987)

Modelled total S-dep

1960-2030

Global interpolated distribution of total (wet + dry) S-deposition (mg/m^2/year) for the years 1960 (a), 1990 (b) and 2030 (C)



How does the addition of sulfate affect the rate of methane emission

- Microbially mediated processes.

- Two anaerobic microbial communities (sulfate reducers and methane producers) are in direct competition over limiting substrates

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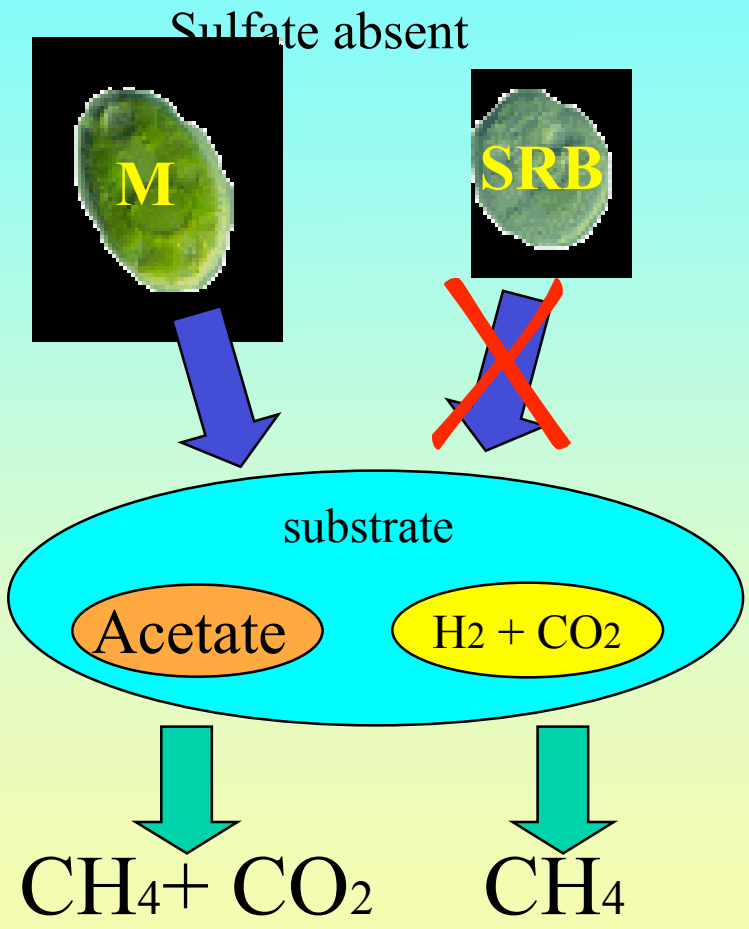
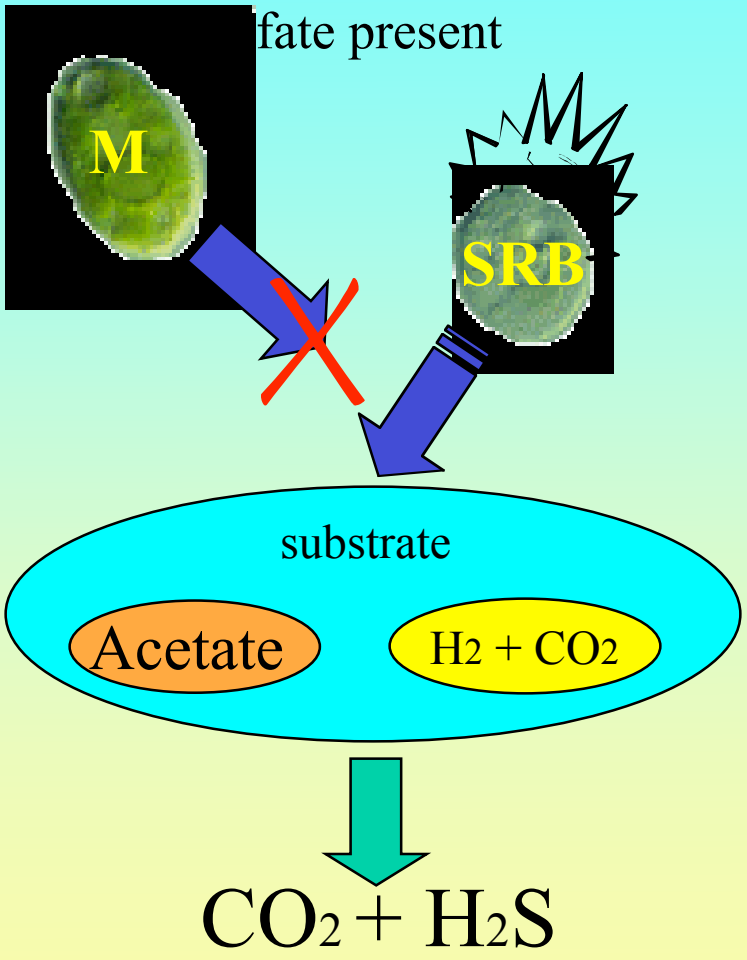
Microbial Competition

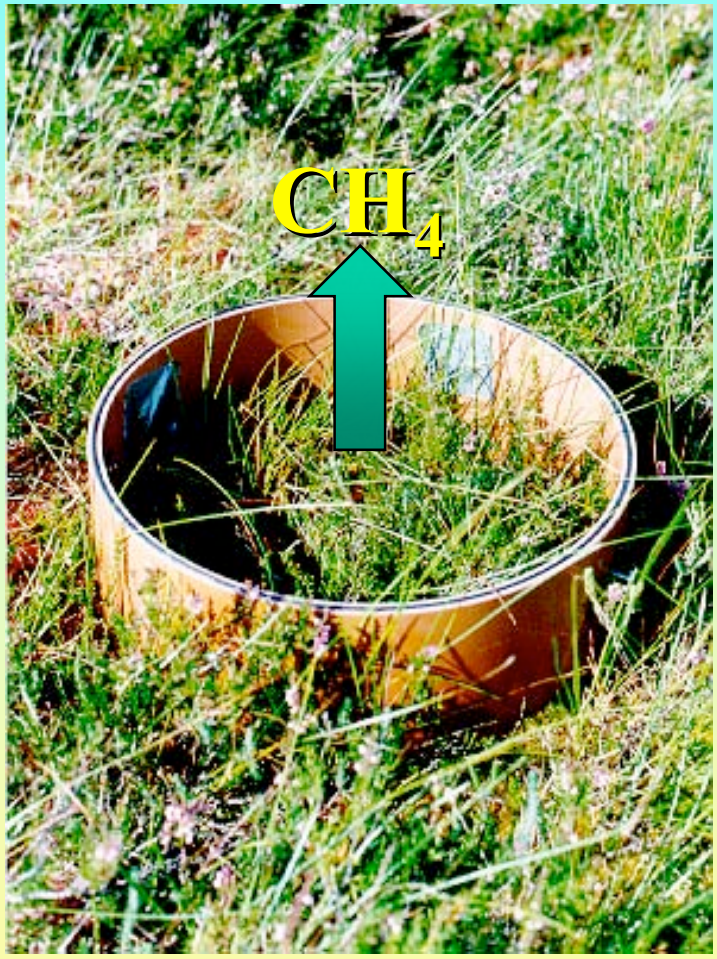




Previous work investigating the link between sulphate and methane emission

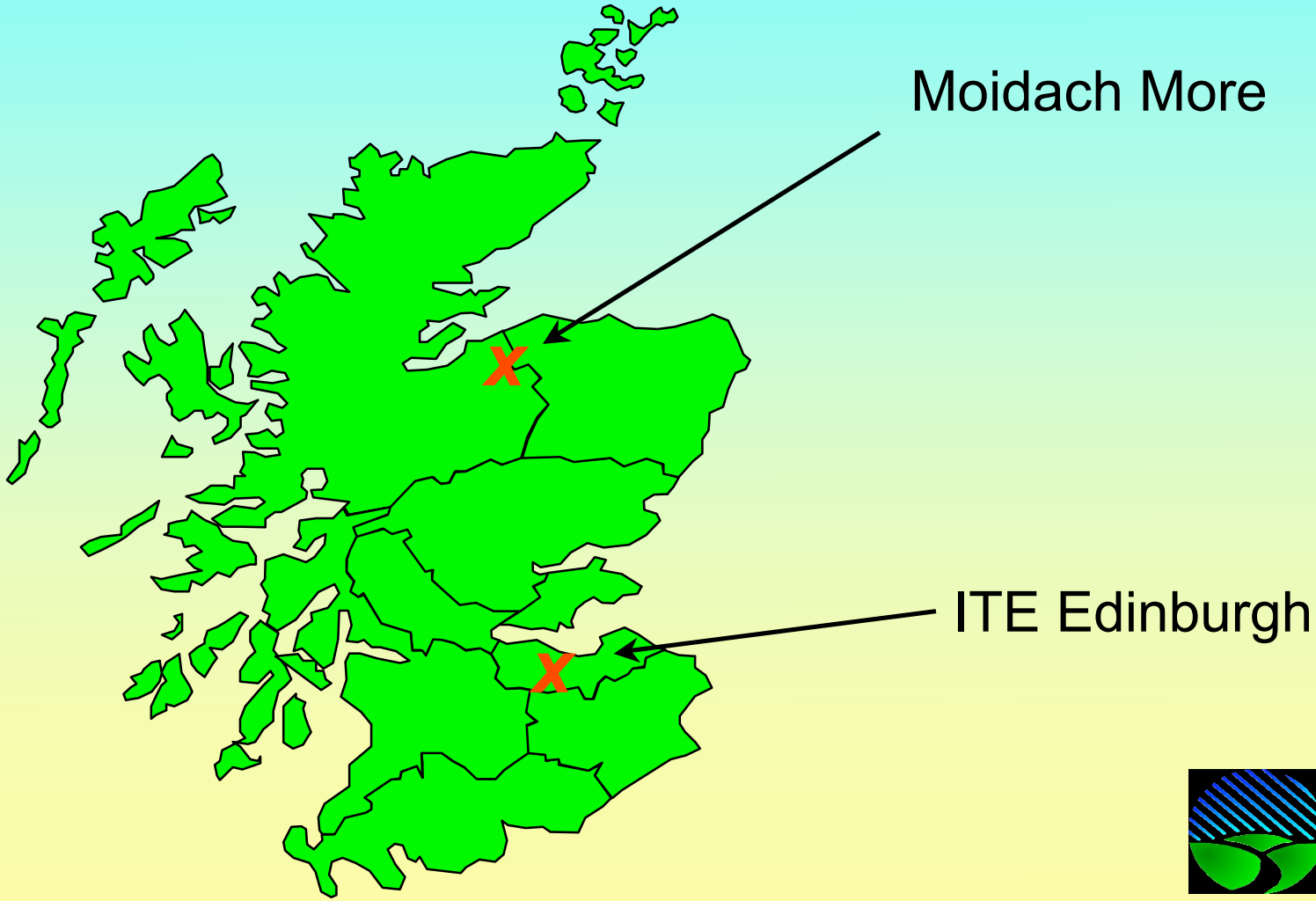
- Single, large fertilisation doses (10^3 kg/ha) rice paddies.
- Lab peat cores in controlled environments (single 'pollution' doses of around 50kg/ha)
- Continuous pollution level doses - (limited data)

Methods

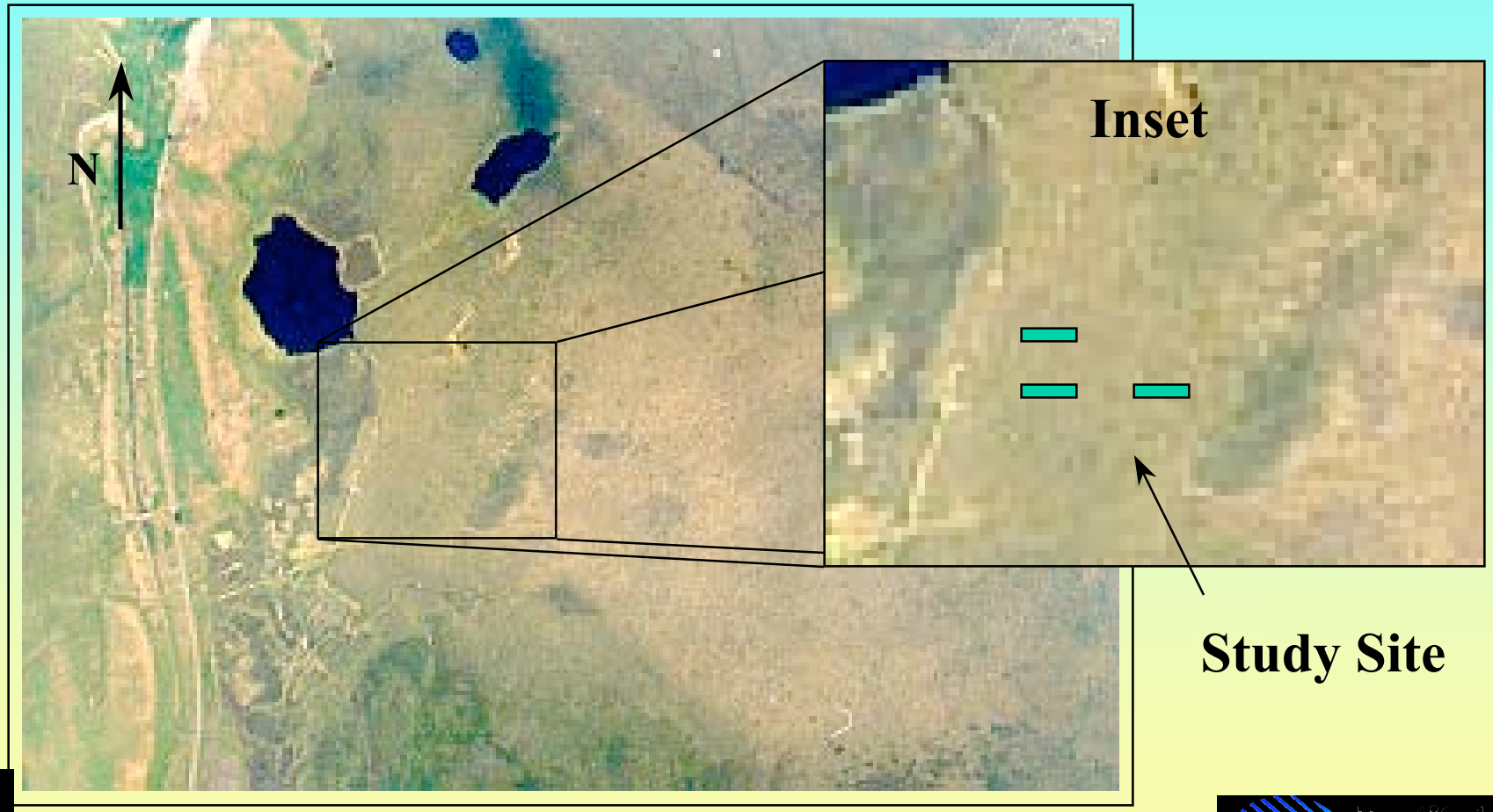


- Field location
- Experimental design
- Static Chamber method

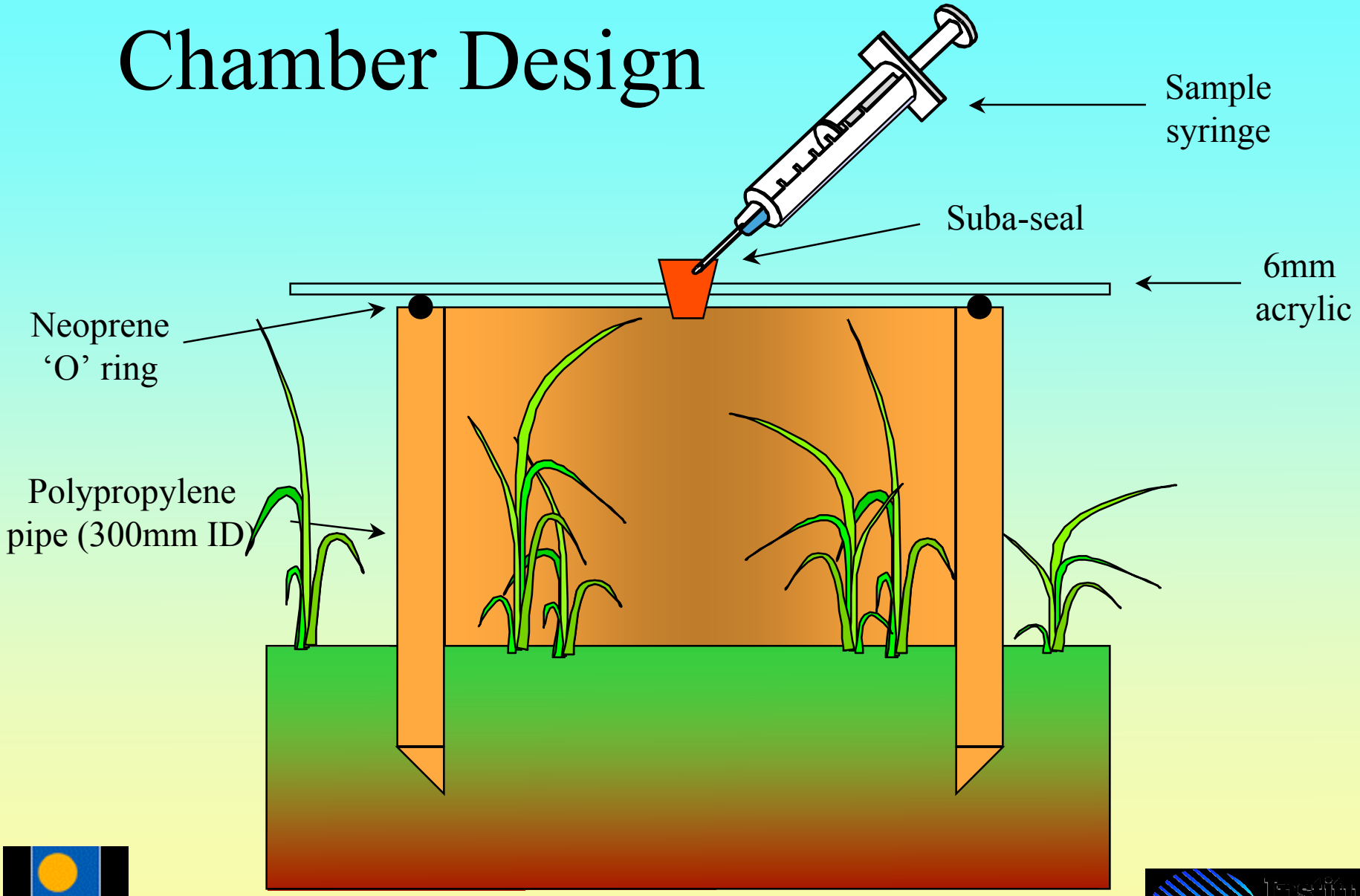
Field Location



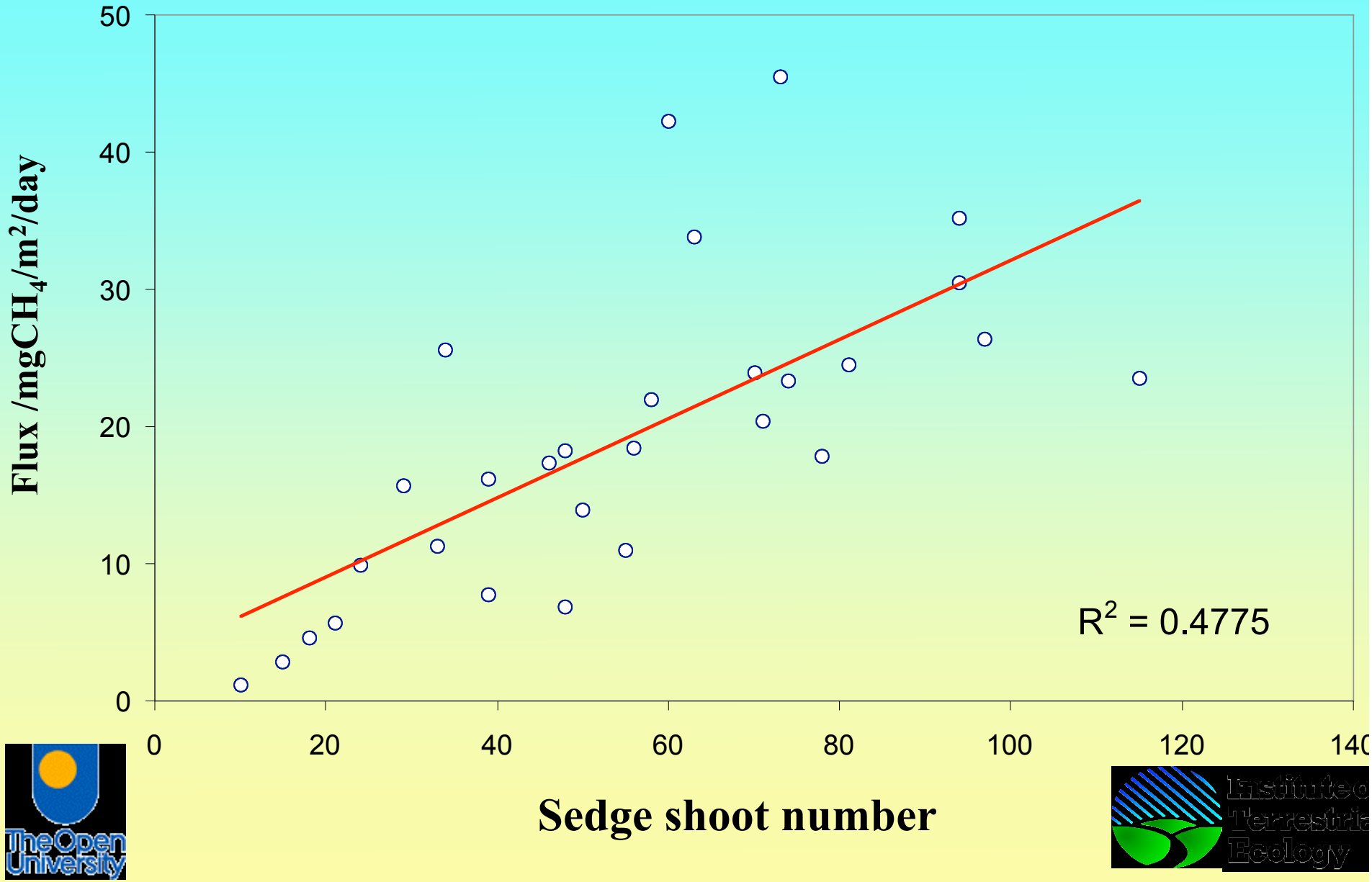
Moidach More



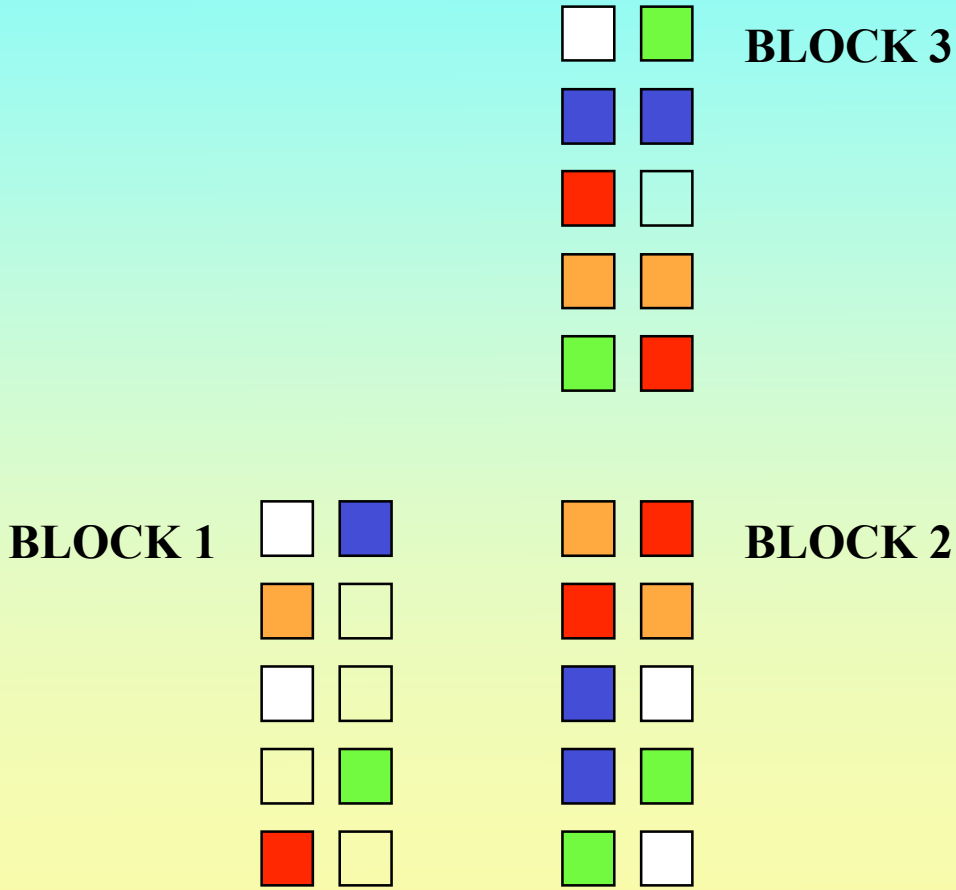
Chamber Design



Relationship between the number of sedge shoots and methane flux

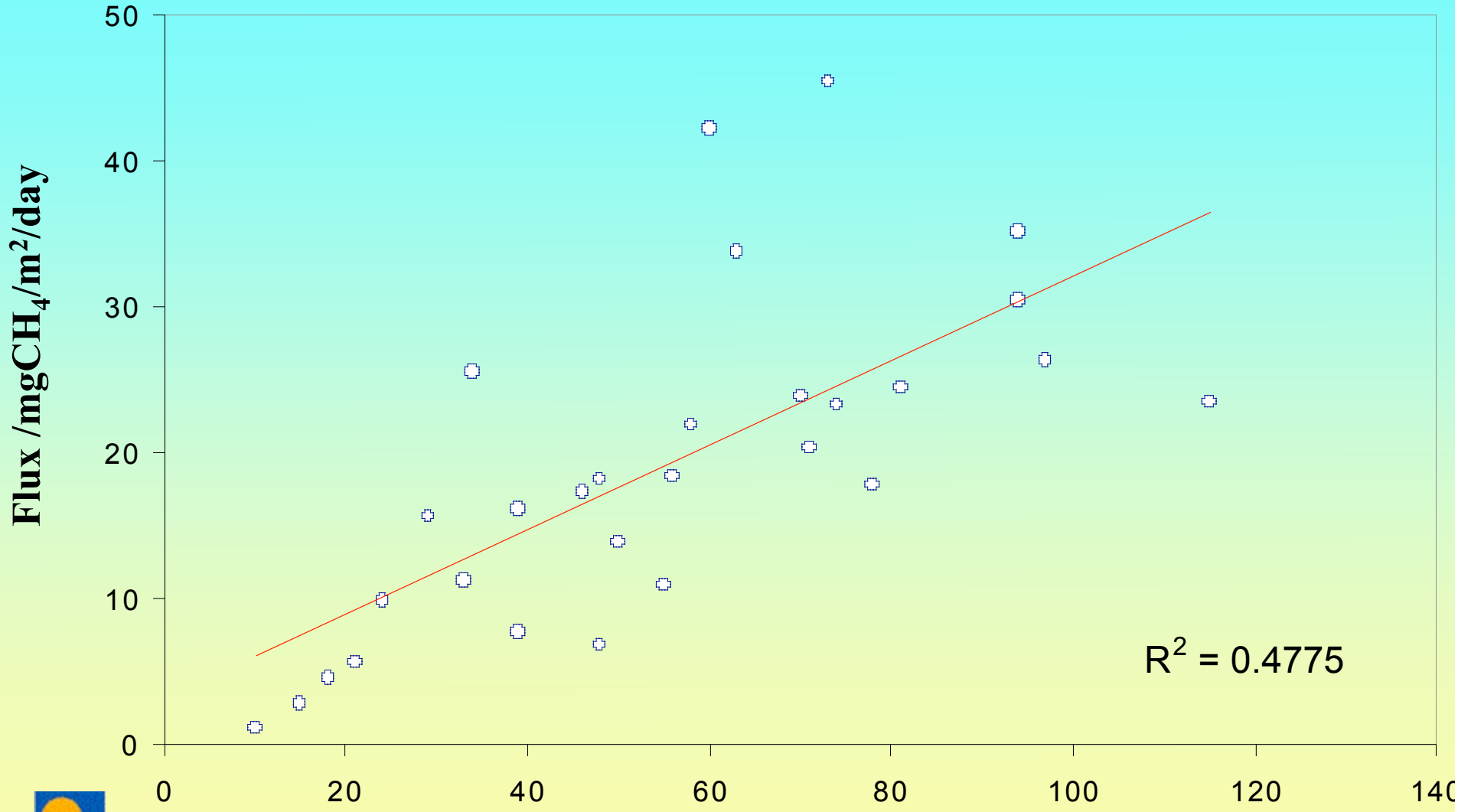


Experimental Design



KEY	TREATMENT
	Controls
	25 Kg SO_4-S
	50 Kg SO_4-S
	100 Kg SO_4-S
	50 Kg SO_4-S (single)

Relationship between the number of sedge shoots and pre-treatment methane flux



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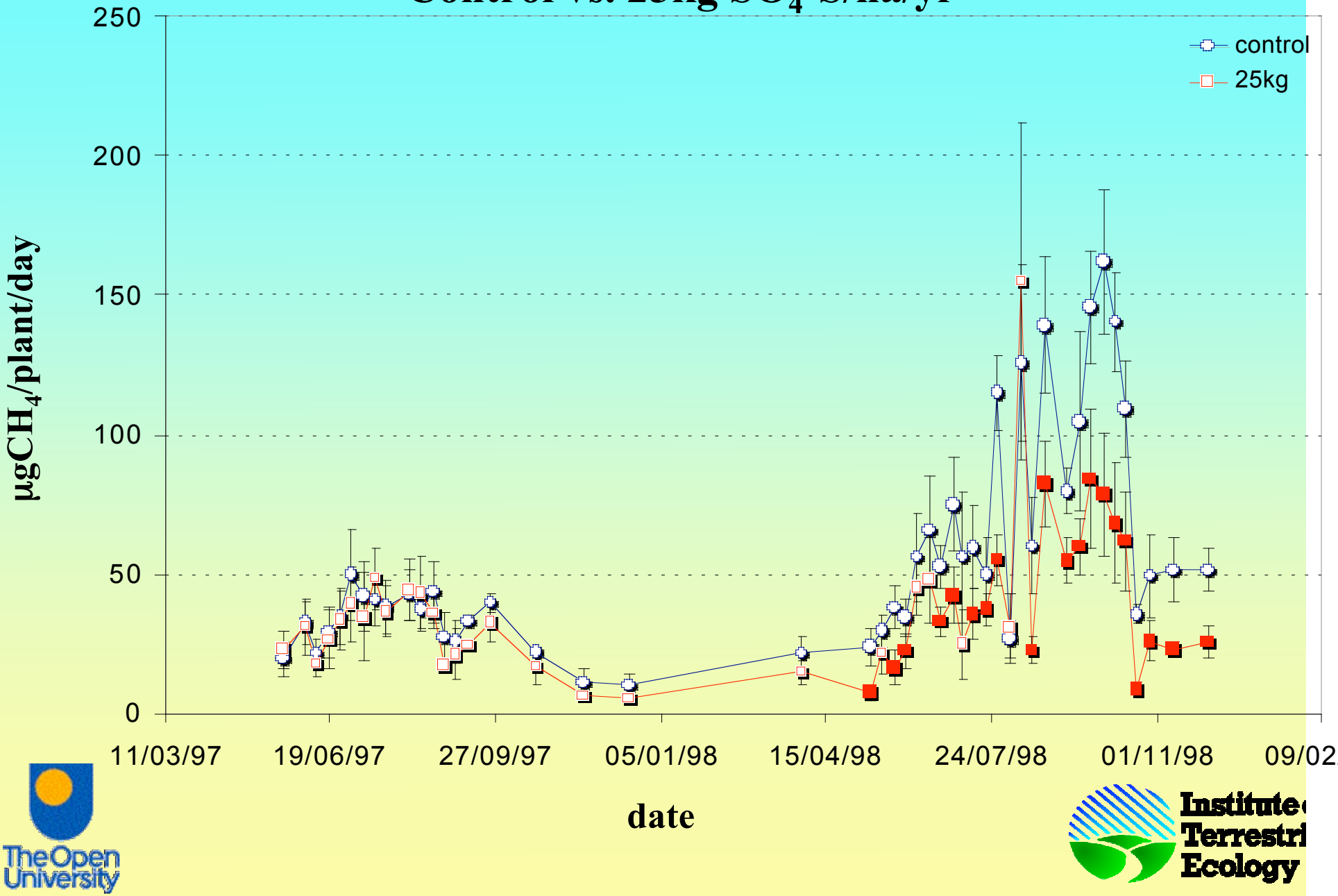
Control vs. 25kg SO_4-S/ha/yr



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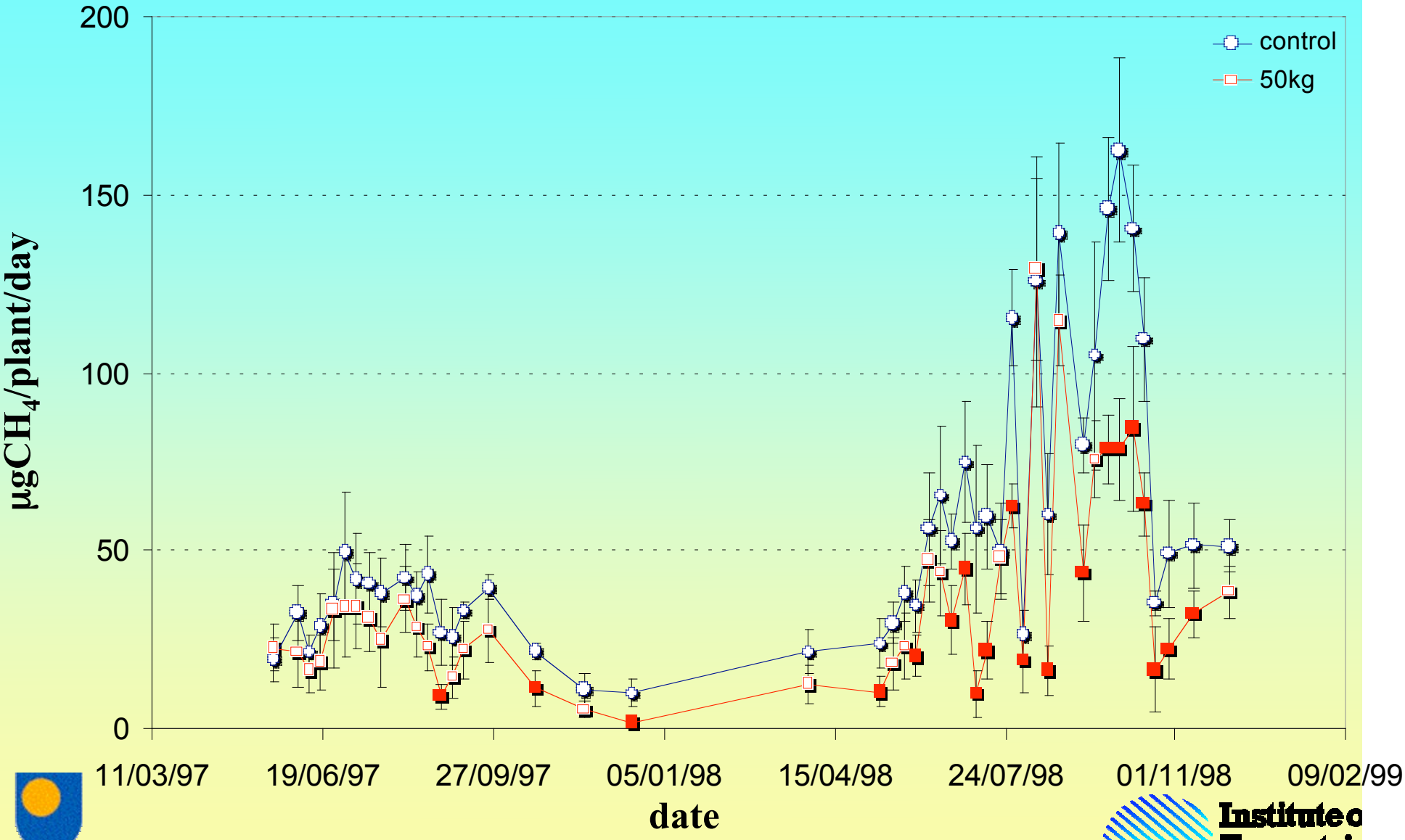
Control vs. 50kg SO_4-S/ha/yr



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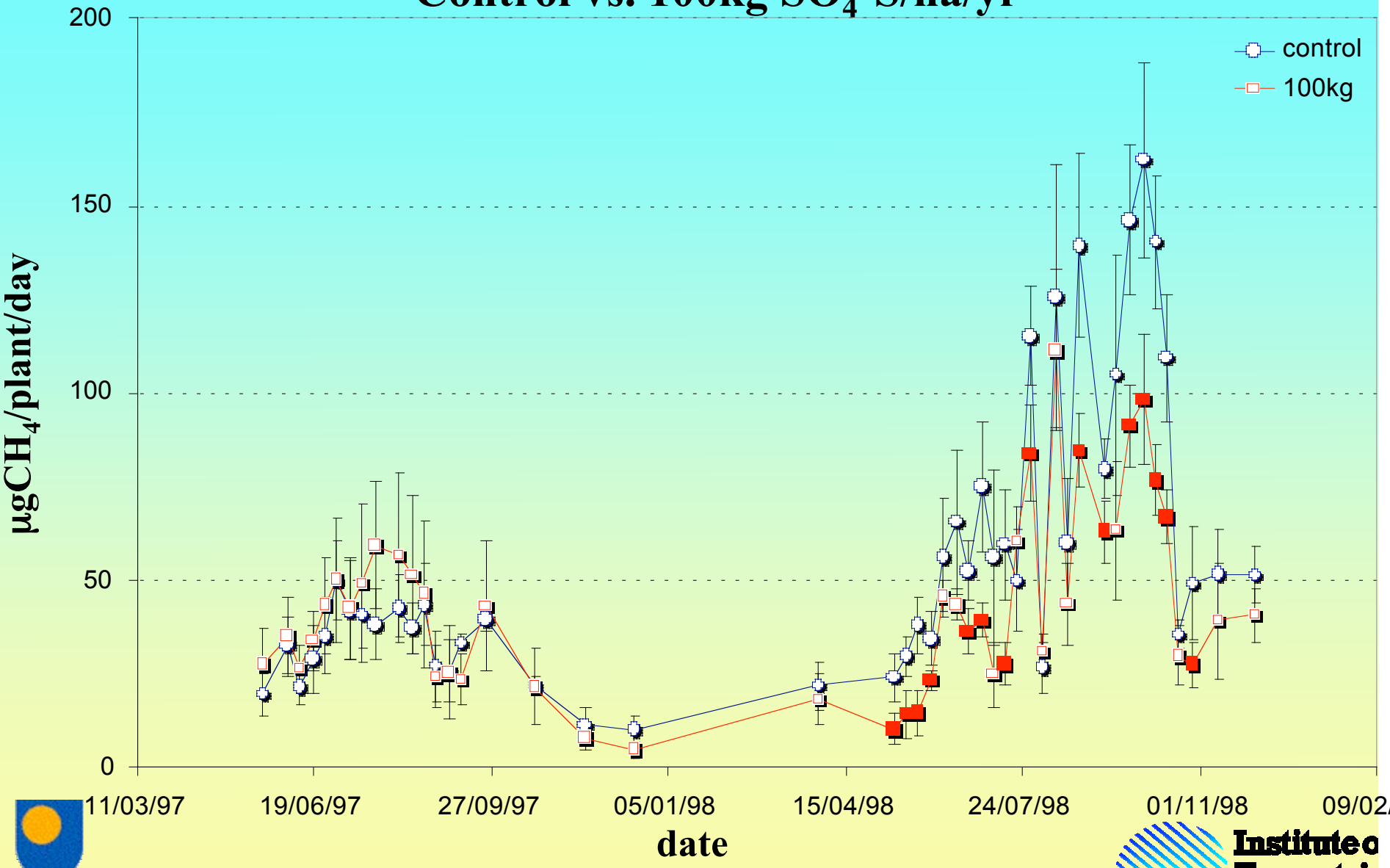
Control vs. 100kg SO_4-S/ha/yr



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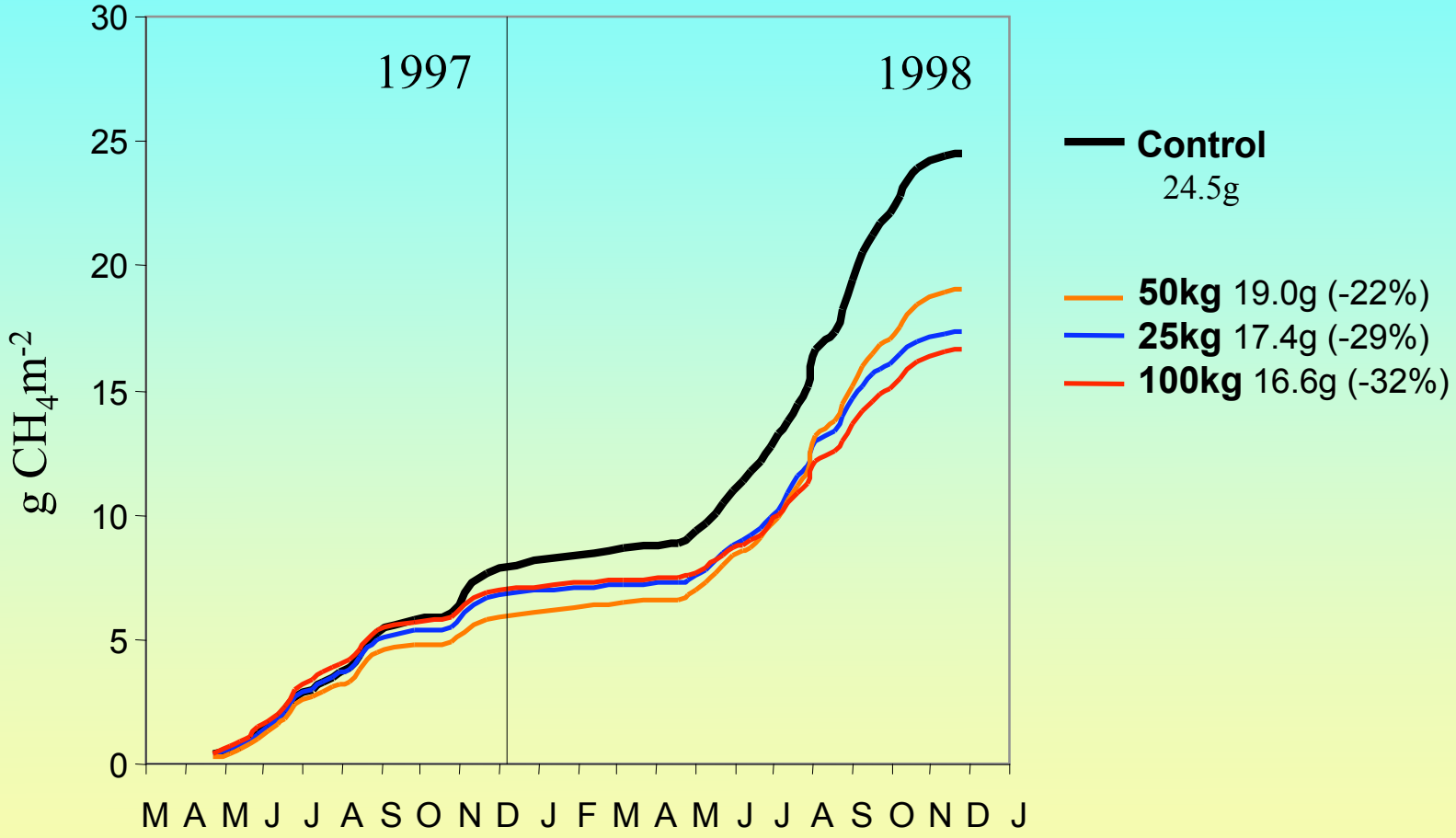
Cumulative mean daily methane flux from Moidach More



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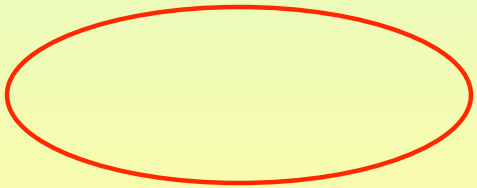
P-value *(Control vs. Treatment)*TREATMENTMean CH^4 Flux (±s.e.)(mg CH^4 .m^{-2}.day^{-1})(a)(b)*Pre-tr*



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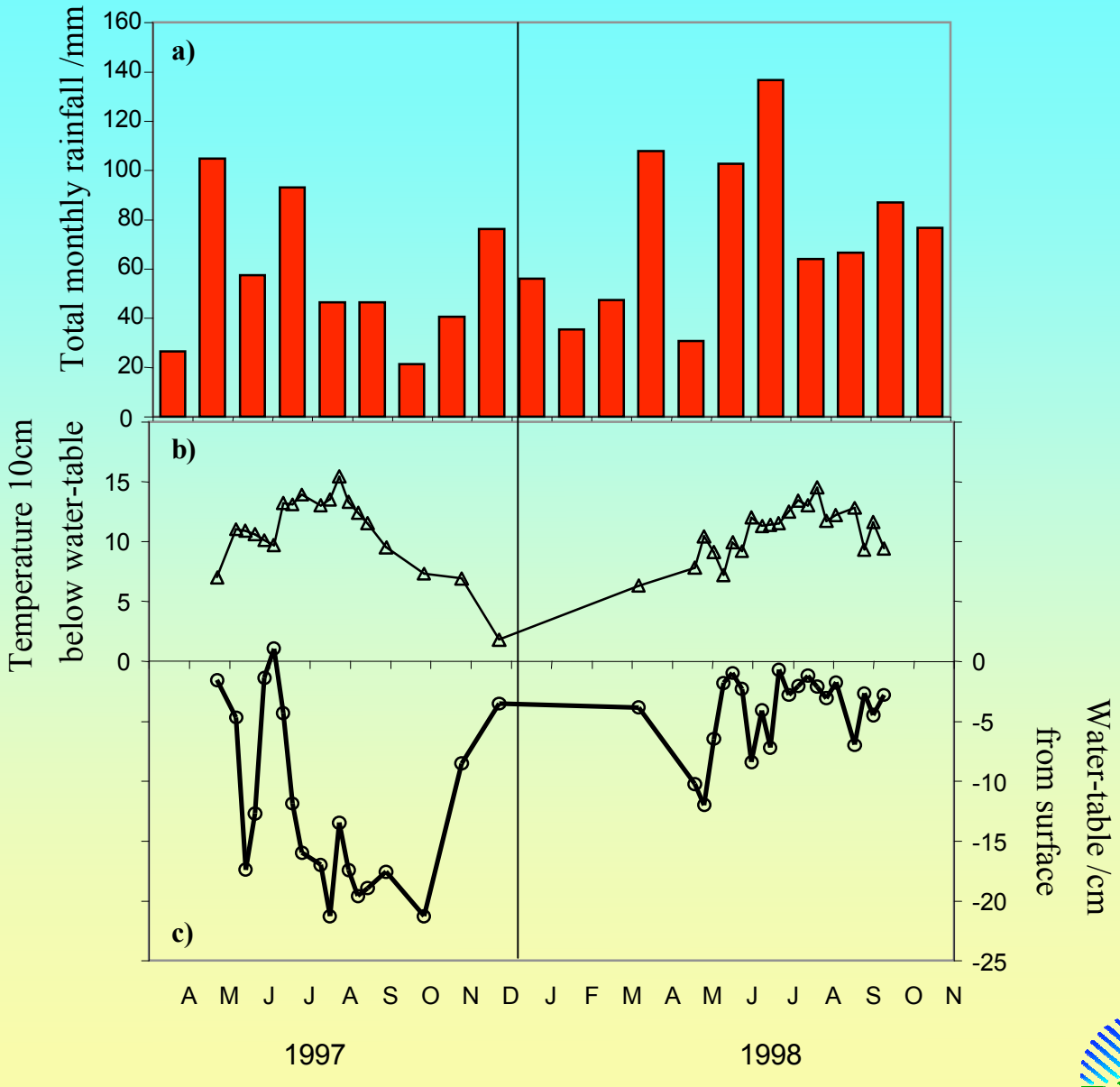
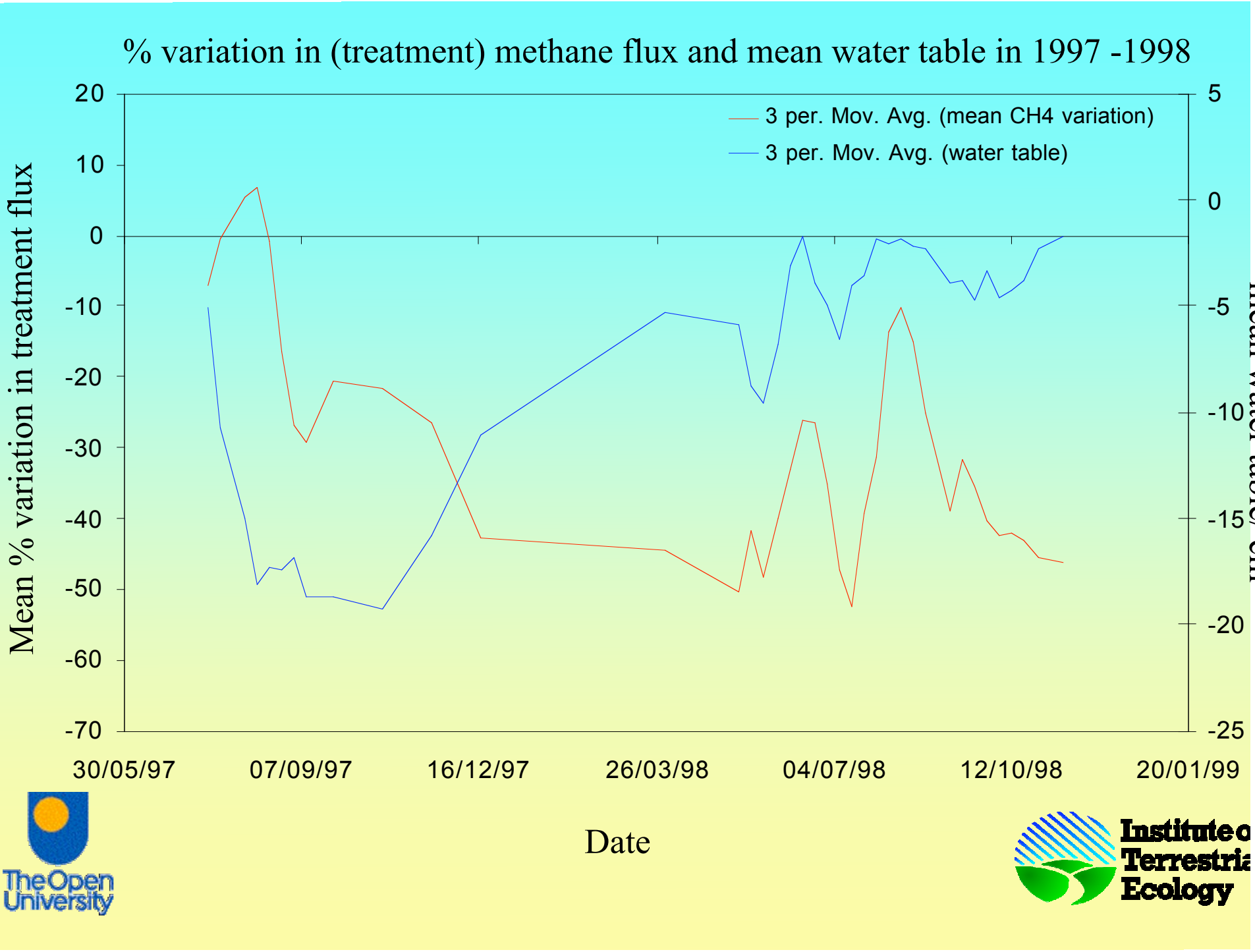
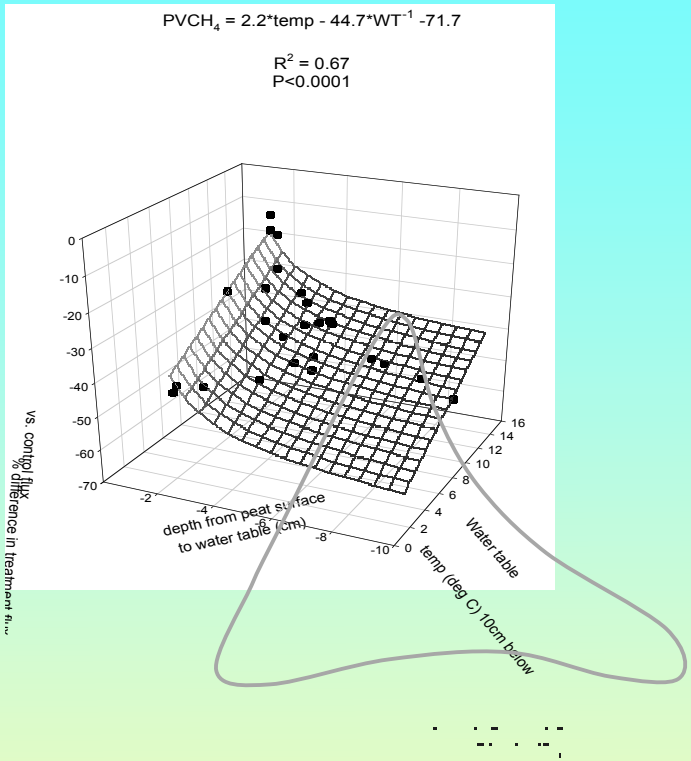


Total monthly rainfall (a), peat temperature 10 cm below water table (b) and mean water-table position (c) over the course of the experiment.


% variation in (treatment) methane flux and mean water table in 1997 -1998
3 per. Mov. Avg. (mean CH4 variation)
3 per. Mov. Avg. (water table)
Mean % variation in treatment flux
mean water table/ cm
20
10
0
-10
-20
-30
-40
-50
-60
-70
5
0
-5
-10
-15
-20
-25
30/05/97
07/09/97
16/12/97
26/03/98
04/07/98
12/10/98
20/01/99
Date



Measured data (•) and modelled data surface showing the relationship between treatment effect, temperature and water table (specific to Moidach More where water-table varied temporally). Heavy lines excludes areas for which no data is available.

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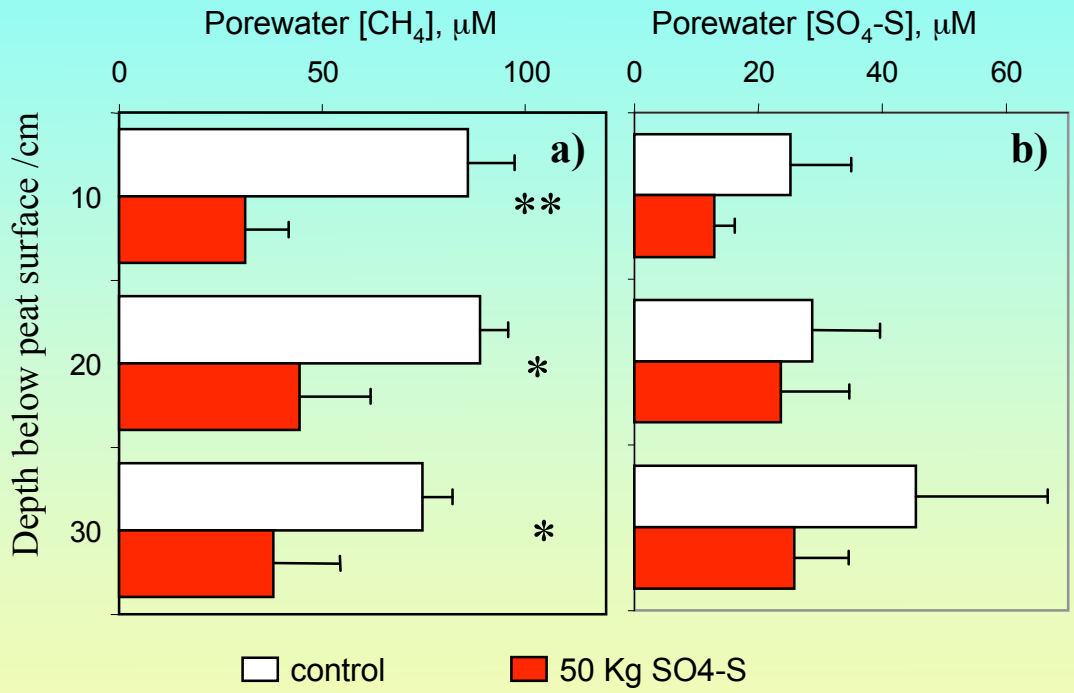
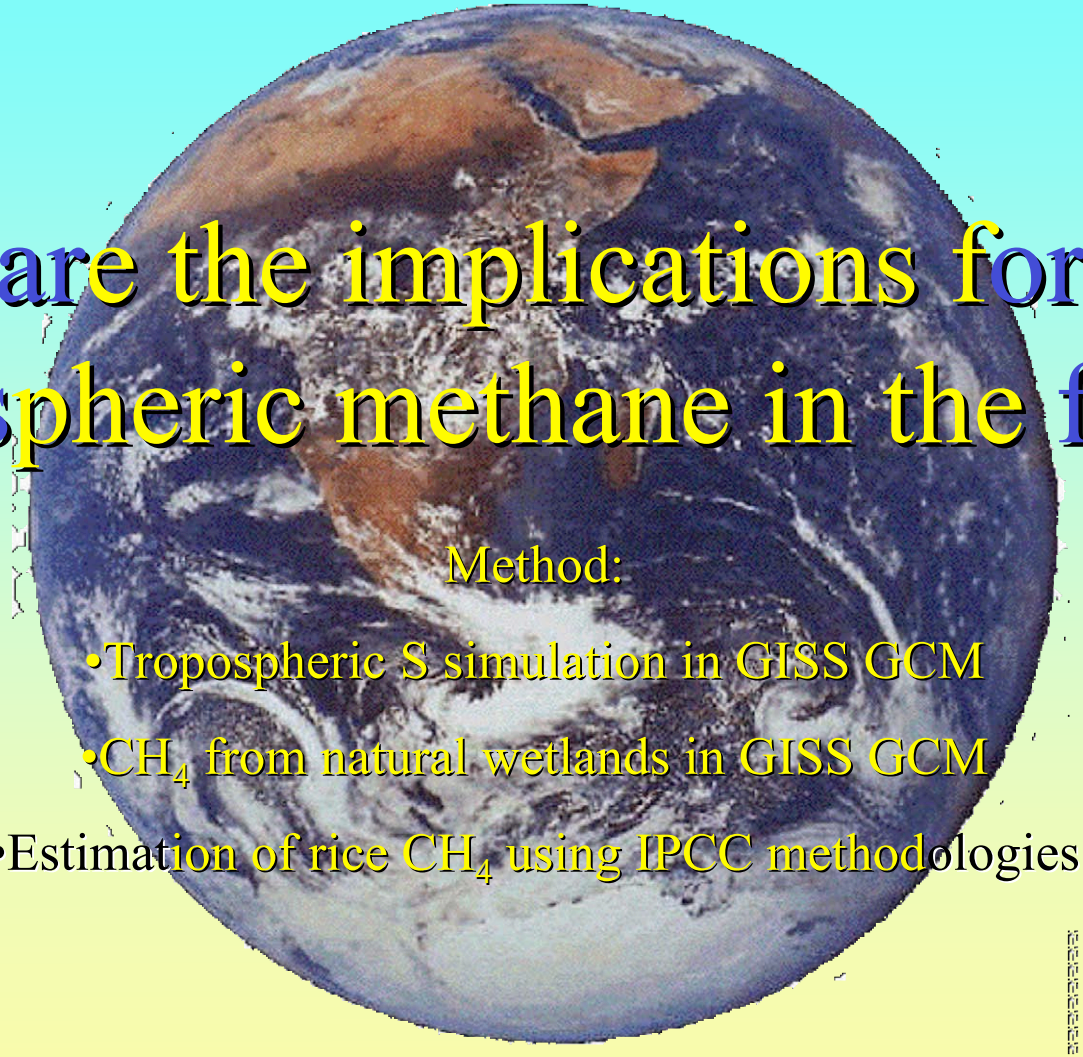
Porewater Chemistry



** P< 0.01 * P < 0.05

What are the implications for global atmospheric methane in the future?



Method:

- Tropospheric S simulation in GISS GCM
- CH_4 from natural wetlands in GISS GCM
- Estimation of rice CH_4 using IPCC methodologies

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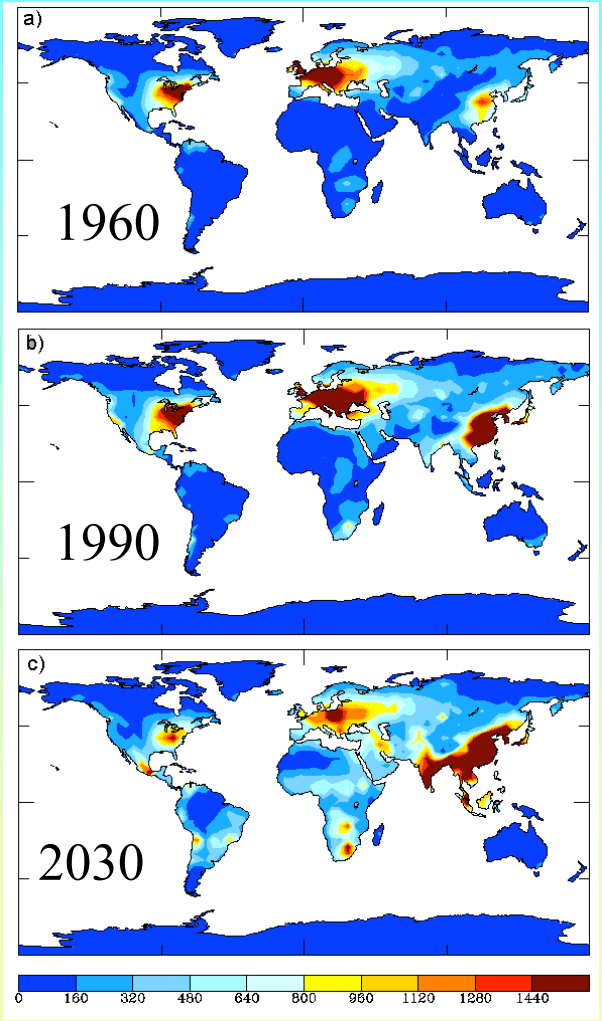
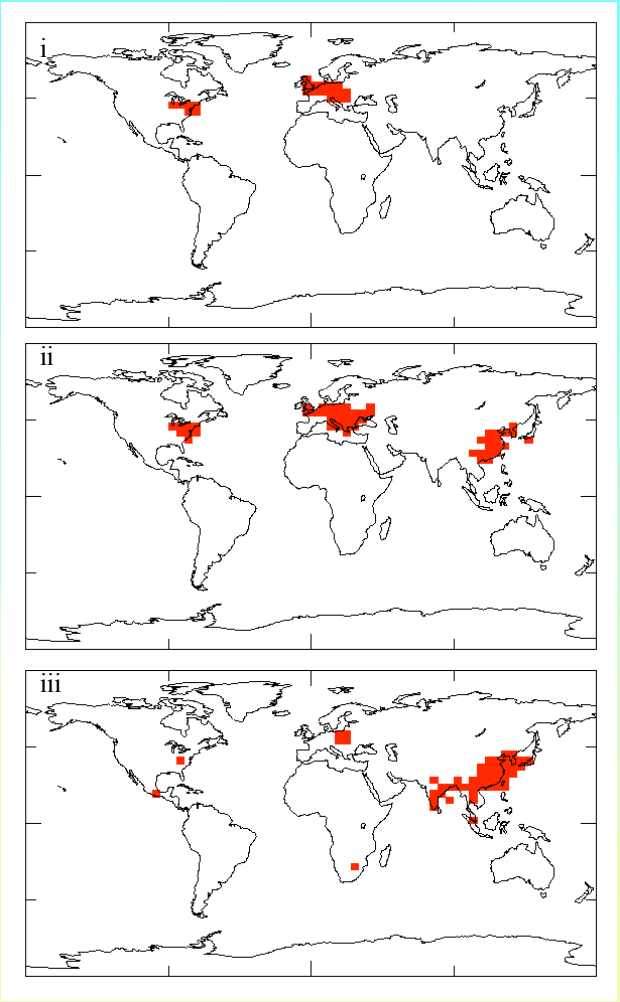
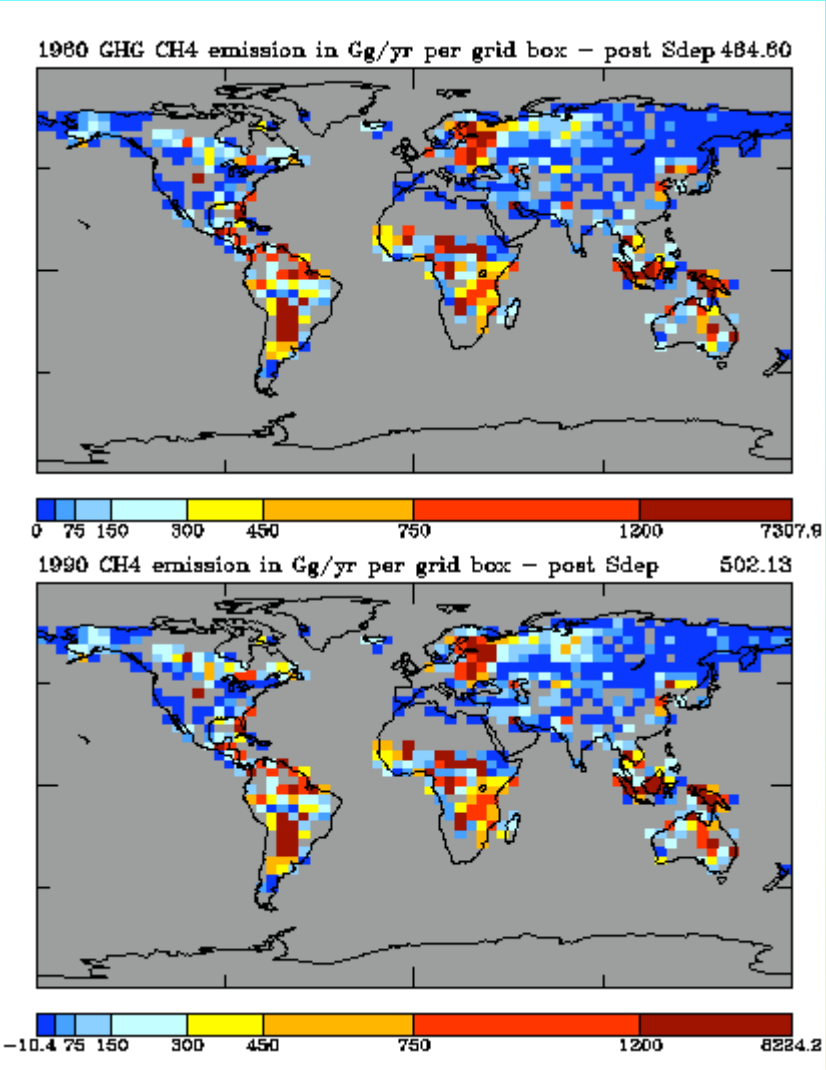
Modelled global S - deposition





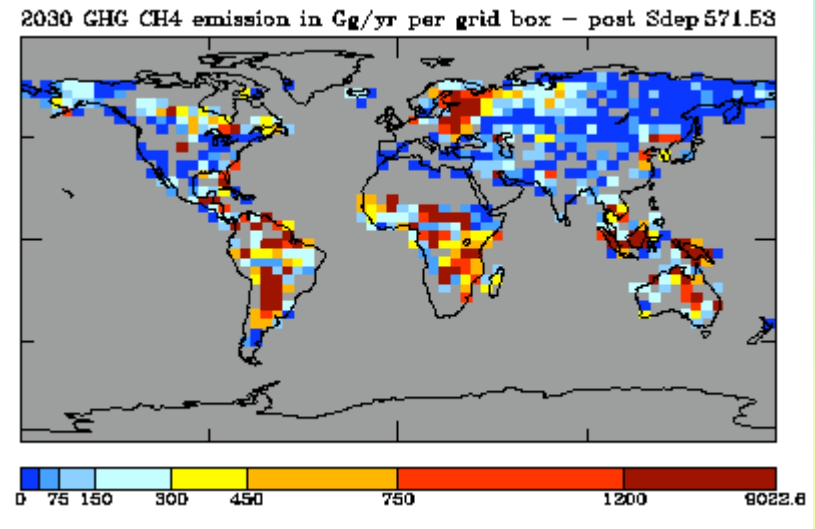
Global interpolated distribution of total (wet + dry) S-deposition (mg/m^2/year) for the years 1960 (a), 1990 (b) and 2030 (C) and areas impacted with S in excess of the 15kg/ha/year threshold for the same years (i,ii,iii respectively).



Natural wetlands

CH_4 emissions

1960-2030



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Modelled Northern Wetland CH_4 Emissions
As Affected by S deposition
(annual CH_4 emissions /Tg)

	Nothern Wetland (>50 deg N[th]) CH_4 flux/Tg	CH_4 flux with S -deposition (Tg)	% flux reduction
1960	33.9	29.2	13.9
1990	39.3	32.4	**17.3**
2030	46.2	39.1	15.4

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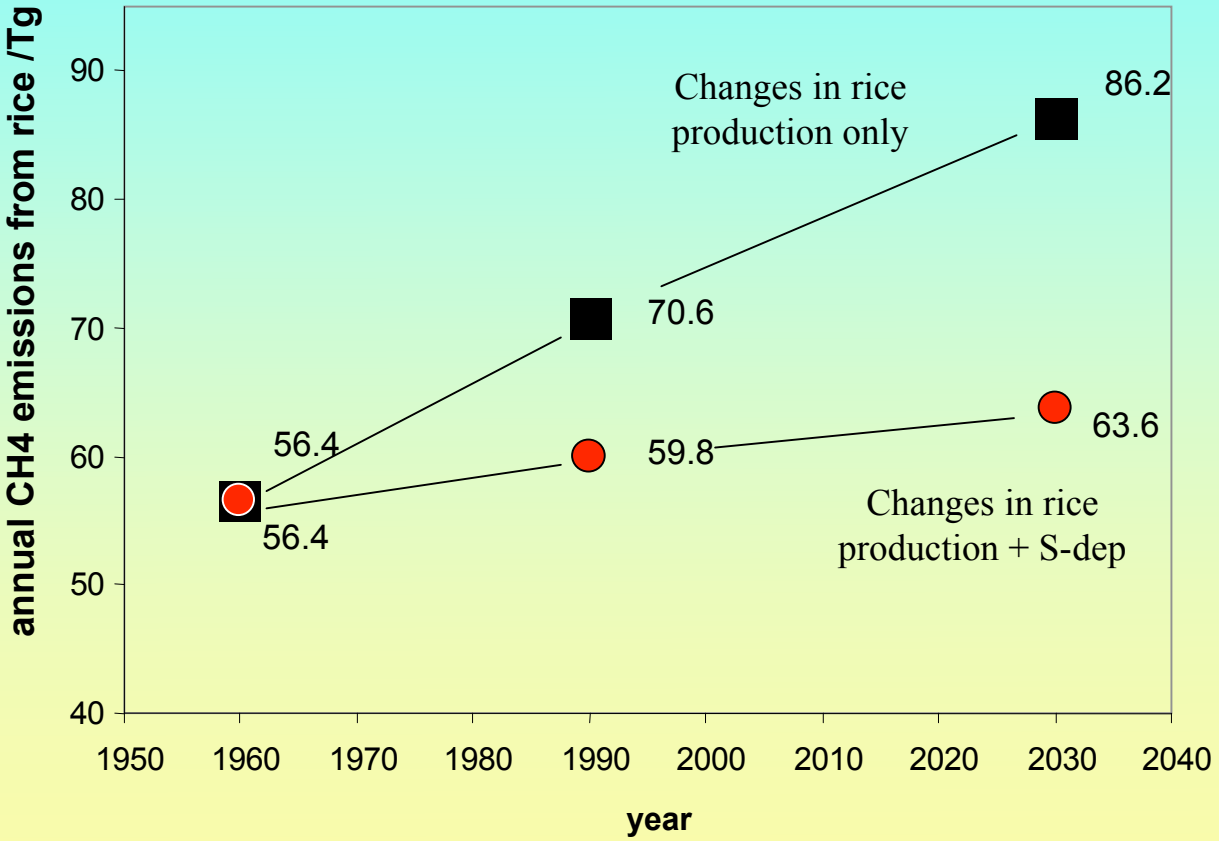
Estimated Rice Paddy

Methane emissions



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