Greenhouse gas emissions: spatial and seasonal variability in two managed peat meadows in the Netherlands and the comparison of small scale and large scale measurement techniques

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Greenhouse gas emissions: spatial- and seasonal variability in two managed peat meadows in the Netherlands and the comparison of small scale and large scale measurement techniques

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Outline

- Context of research
- Methods and instrumentation
- Spatial variation of GHG emission in fen meadows
- Up scaling of small scale measurements to larger temporal and spatial scales
- How does emission change with management?
- Conclusions

World's peatlands..

- ..contain nearly 30 percent of all land-based carbon (550 GT carbon).
- ..are being degraded world wide as a result of unsustainable development of peatlands
- .. organic carbon is being released in the form of CO2; currently already an amount of 3000 Mt carbon dioxide per year
- :Climate change is significantly fueled by the destruction of the world's peatlands

Veenweide vroeger en nu

Opslag van CO_2

50% atmosferisch C is opgeslagen in het veen (Dolman et al., 2008)

Verlies van CO_2

Drainage veroorzaakt verlies van het veen (Dolman et al., 2008)

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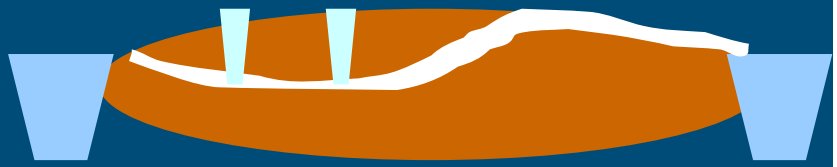
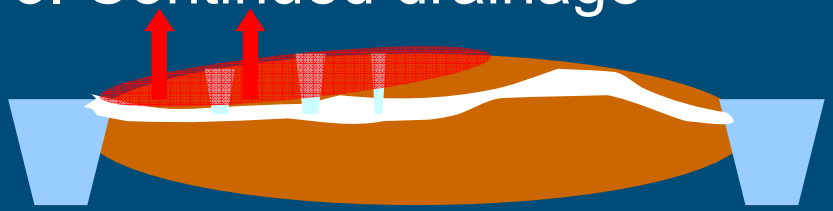
1. Natural situation

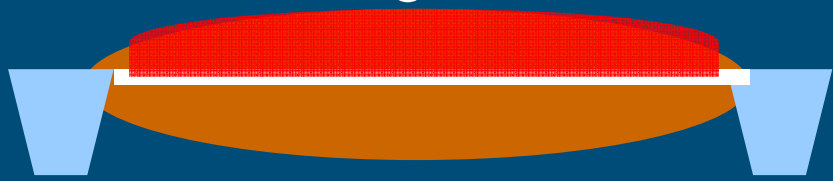
2. Drainage



3. Continued drainage



4. End stage



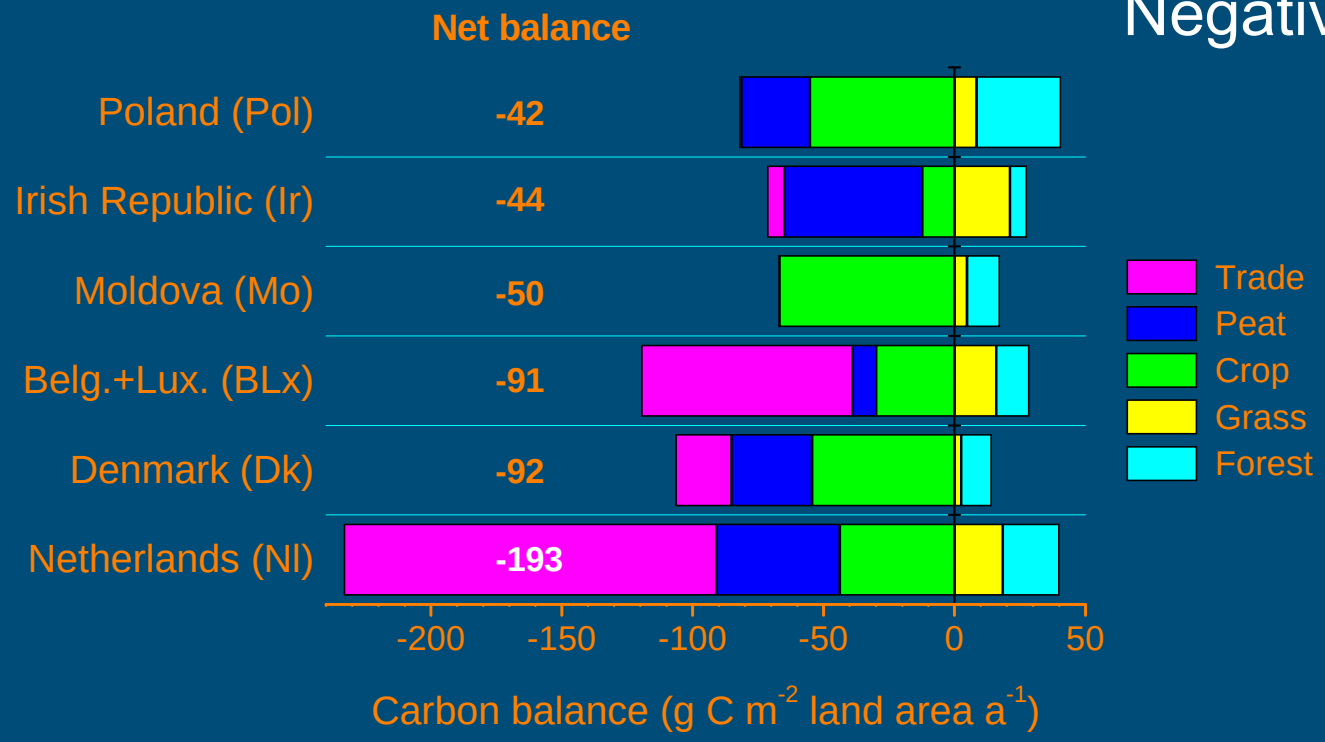
Unless…….

- Peatland conservation and Management strategies do improve

Peatlands in the Carbon balance

Positive: uptake

Negative: loss



Janssens et al. (2003) *Science*, 300

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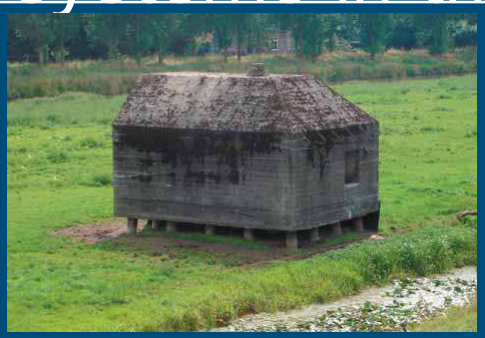
Fen Meadow Ecosystems in the Netherlands



Fen meadows are mainly used for intensive farming,

but will this change in the future?

Nature reserve biomass production

Fen meadow parks

Bron: Alterra

Water storage/recreation

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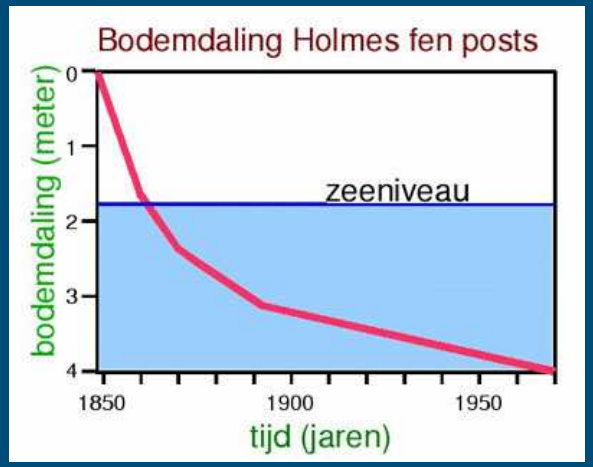
Het veen verdwijnt!



Land surface in 1848

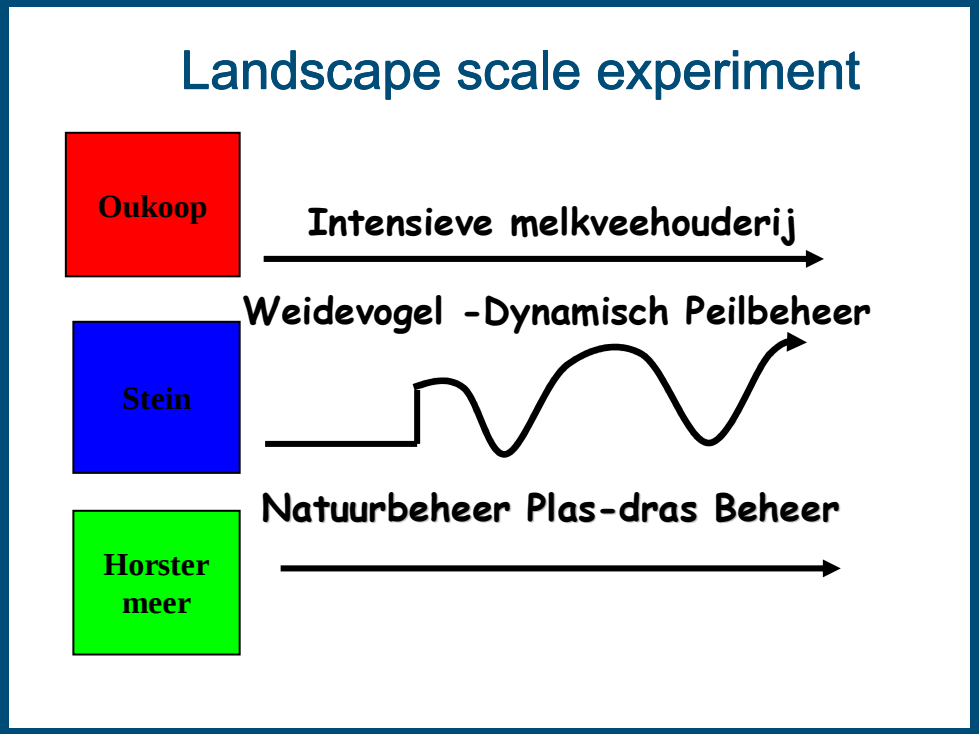
CO_2 naar atmosfeer

Oxidatie van het veen

Drainage veroorzaakt oxidatie van het veen en dus bodemdaling

Land surface in 2000

Research areas



Intensive management

WU/ECN

Extensive management

WU

No management

VU

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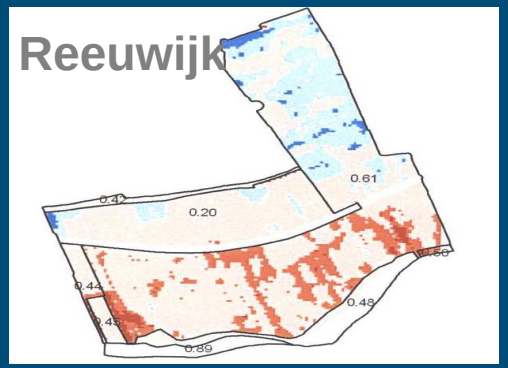
Meetlocaties



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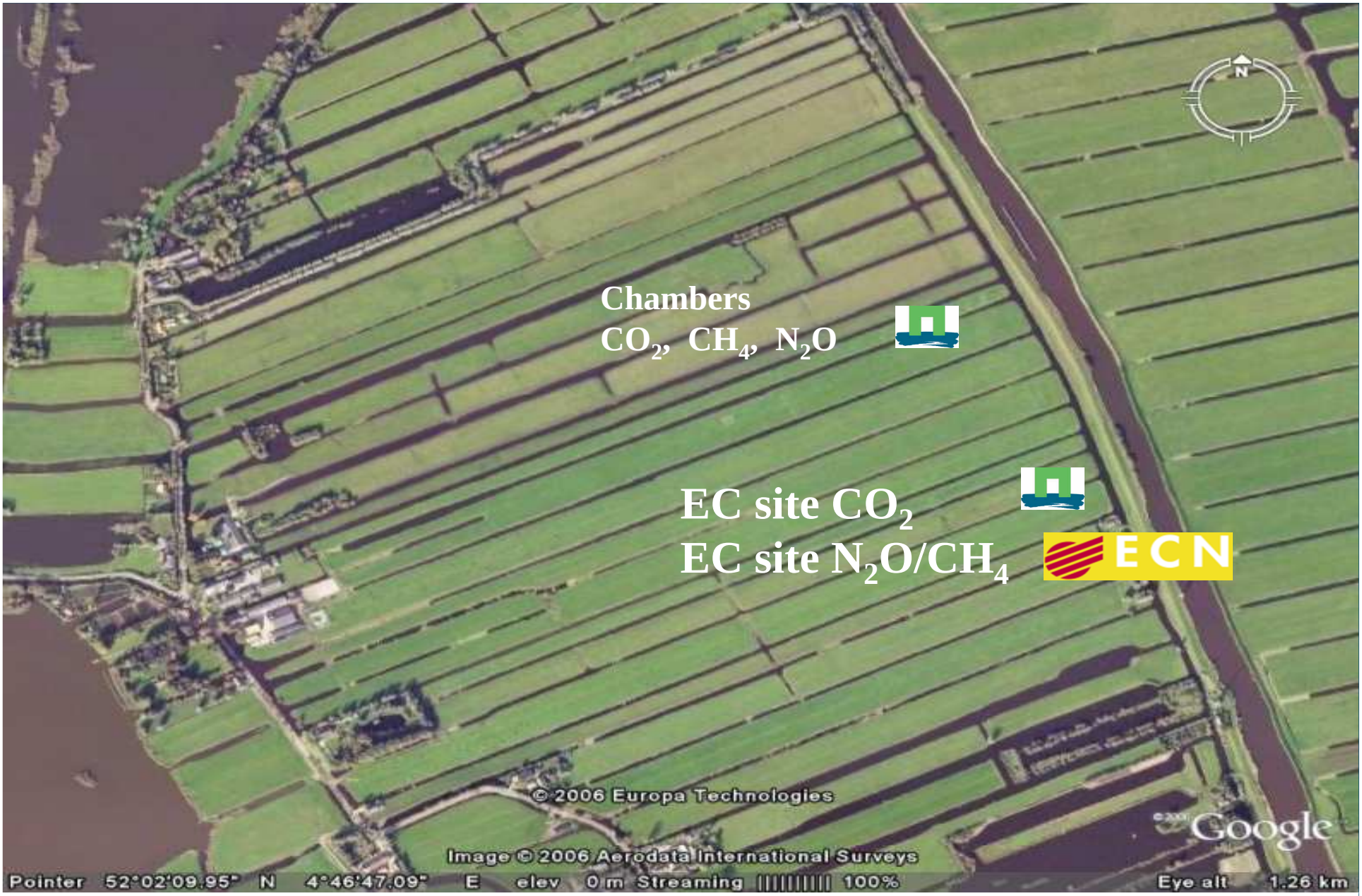

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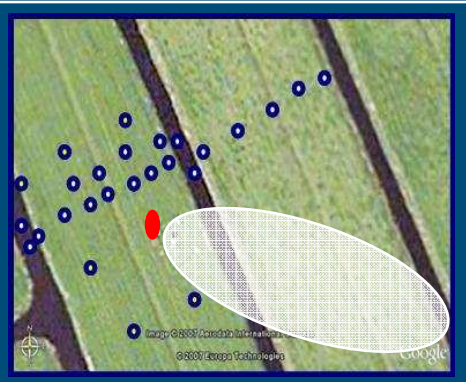
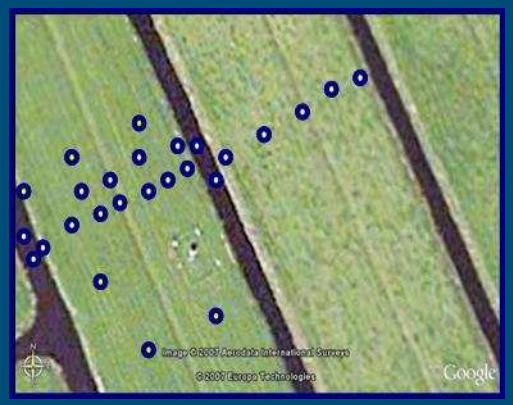
Methods



- Small scale Chamber measurements CO2 and CH4
- Larger scale Eddy covariance CO2 and CH4



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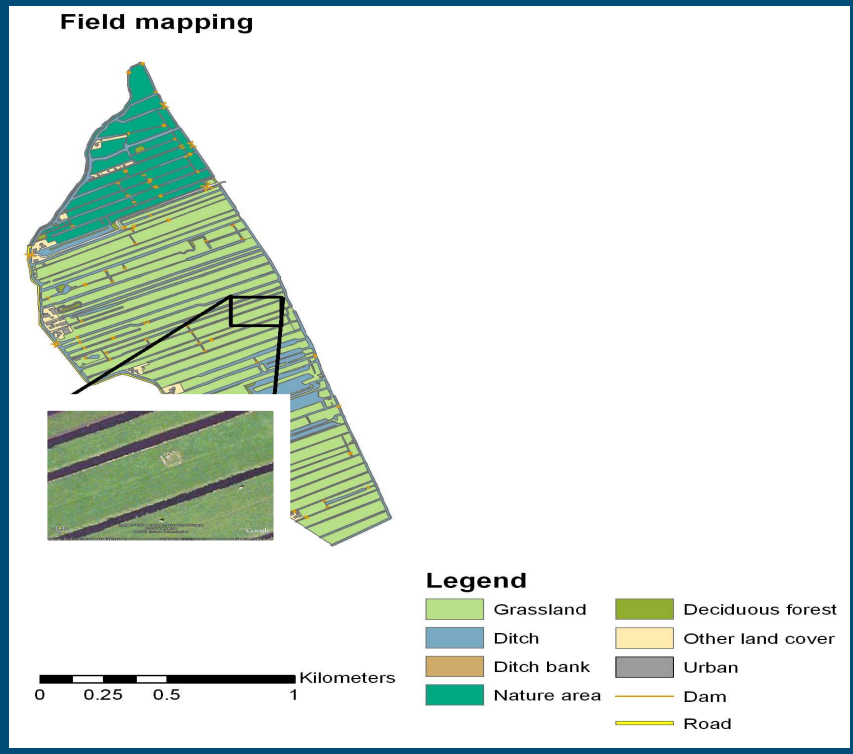
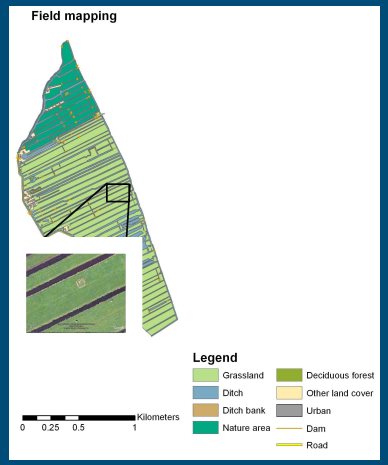
Spatial variation

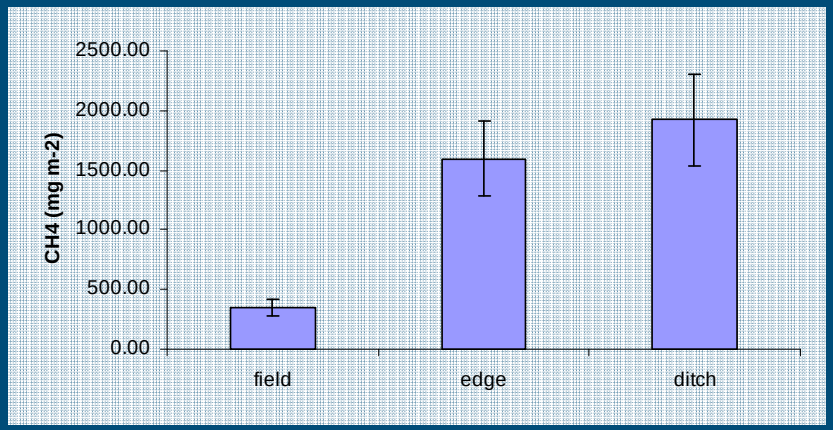
- Field (79%)
- Ditch Edge (5%)
- Ditch (16%)



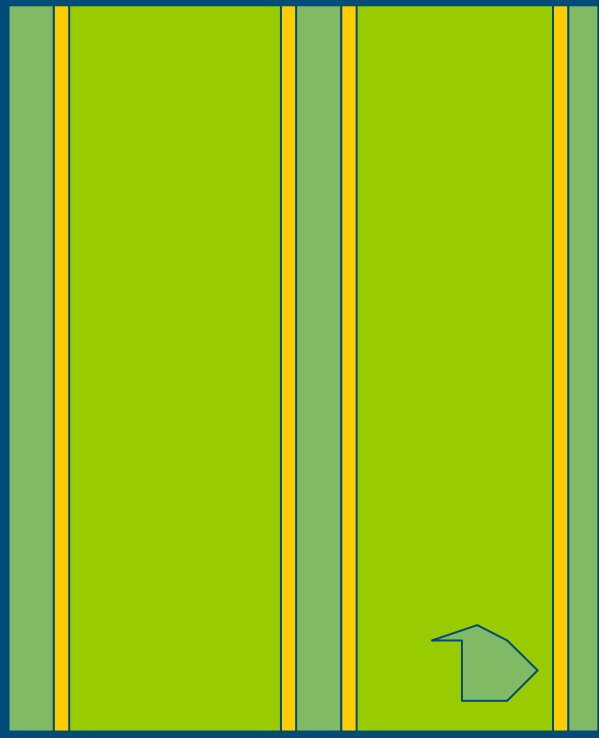
Ditches and ditch edges appeared to be CH4 hotspots!

Ruimtelijke variatie van CH_4 emissie





Emissies bepalen per landvorm



Opschalen van emissies

Rekening houdend met de

Verschillende bijdragen van

De landvormen

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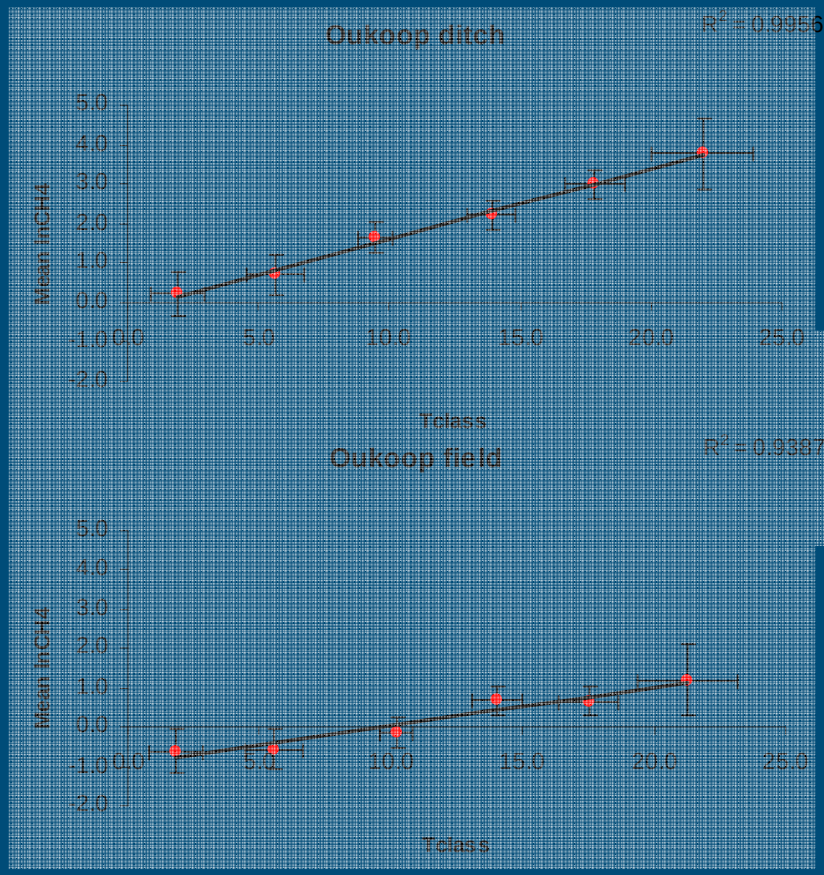
	Tsoil	Tair	Moist.	WT	Twater	pH	EC	Tsoil	WT	Windvel.
Oukoop chamber measurements								**Oukoop EC measurements**		
Field	0.265** (n=195)	0.545** (n=134)	-0.235* (n=119)					0.481** (n=2540)	-0.081[5] (n=77)	0.063**[5] (n=2545)
Edge	0.397** (n=80)	0.350** (n=74)	-0.237* (n=73)							
Ditch		0.422** (n=90)			0.478** (n=97)	0.173[1] (n=30)	0.503**[3] (n=26)			
Stein chamber measurements								**Stein EC measurements**		
Field	0.474** (n=186)	0.279* (n=190)	-0.166* (n=146)	0.177[5] (n=36)				x	x	x
Edge	0.500** (n=64)	0.473** (n=60)	0.05 (n=59)							
Ditch		0.424** (n= 59)			0.496** (n=76)	0.035[2] (n=30)	-0.072[4] (n=30)			

Schrier et al., in prep

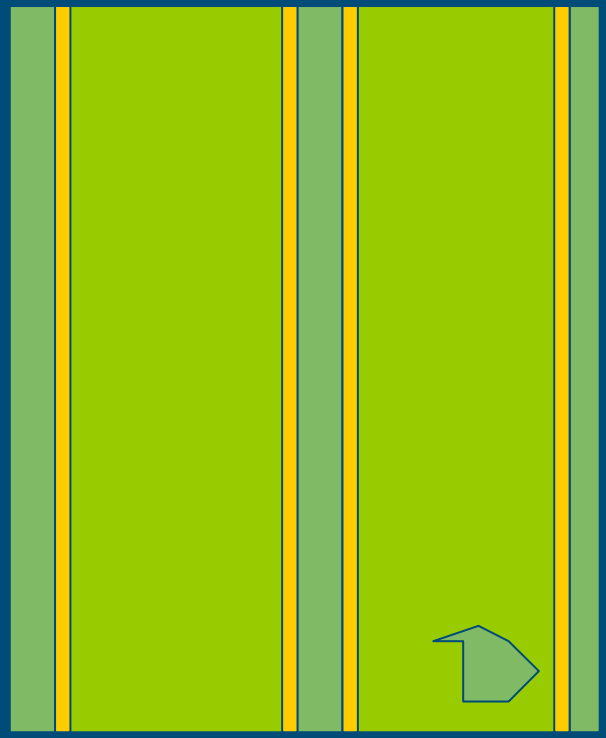
Up scaled chamber measurements

Emissions per landform



Up scaled total emission

Weighted for each landform



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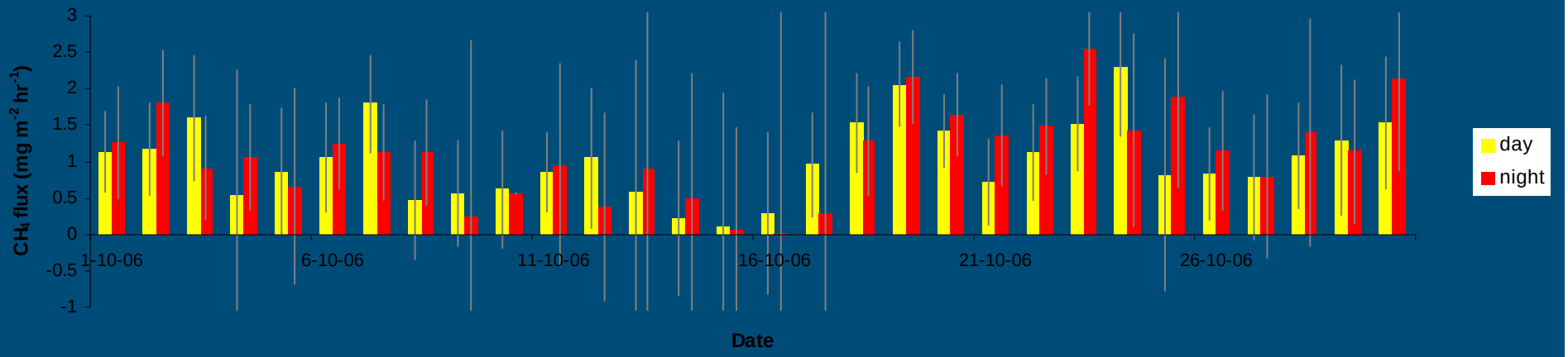
Test for diurnal variation



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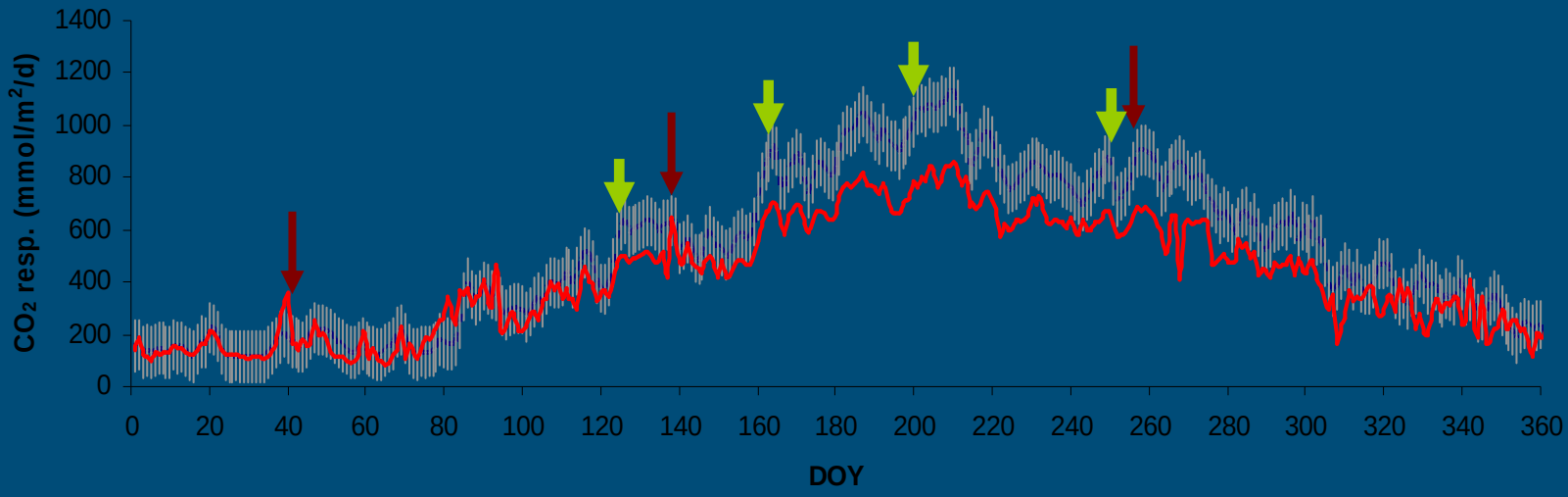
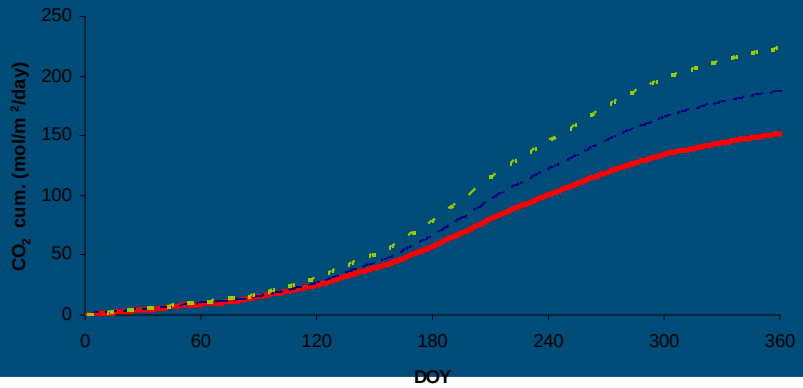
CO2 fluxes measured by two independent methods



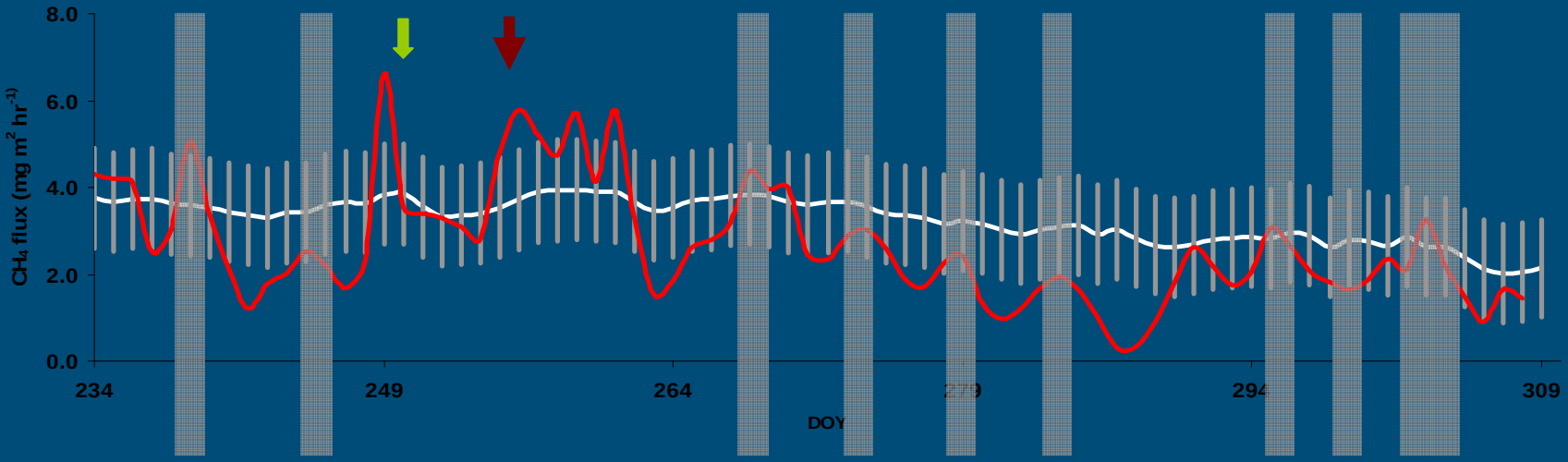
EC

Chamber based



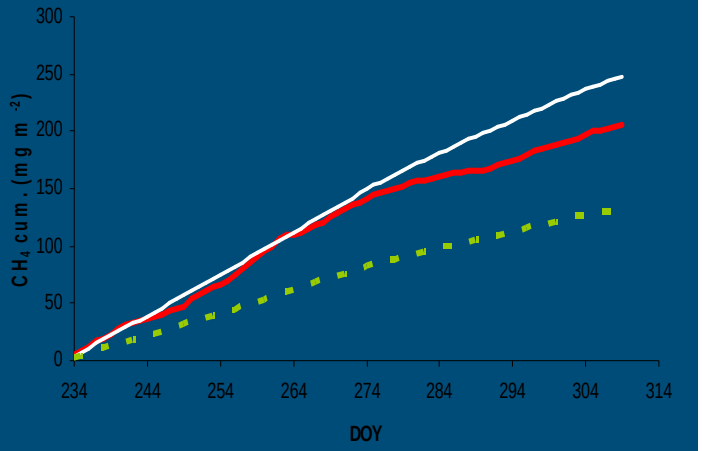
Schrier et al., submitted AFM

CH4 fluxes measured by two independent methods



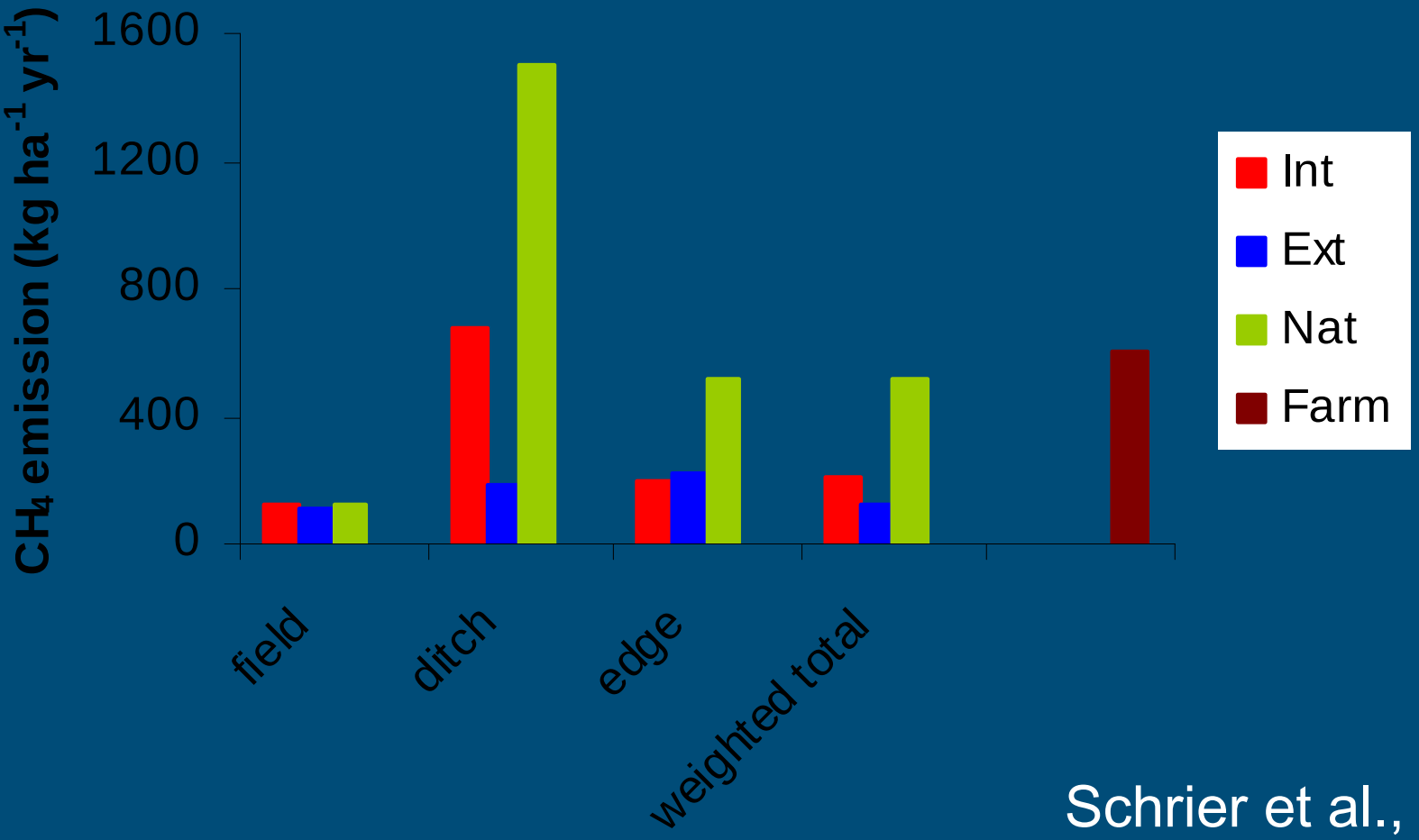
EC

Chamber based



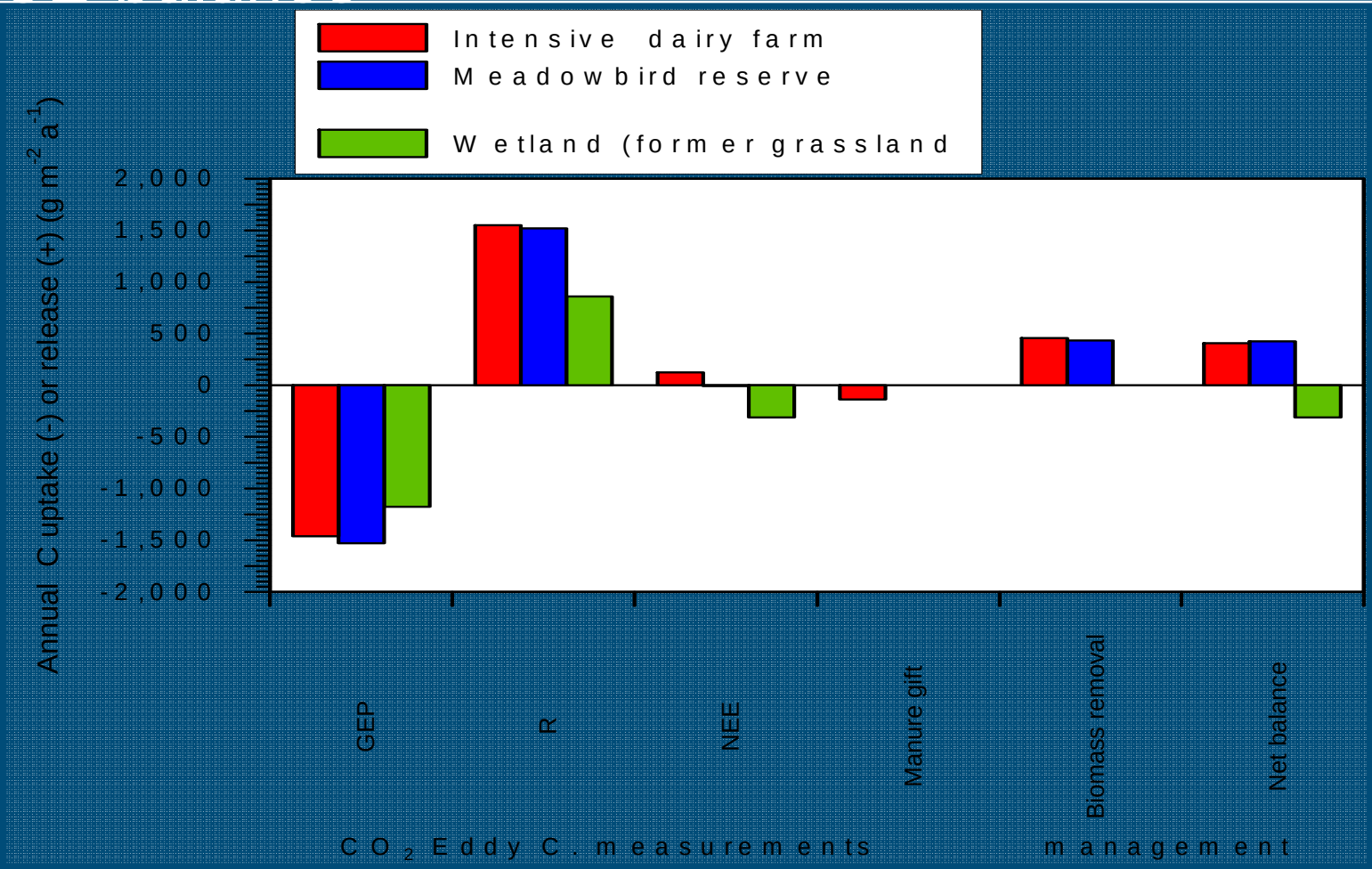
Schrier et al., submitted AFM

Methane balance



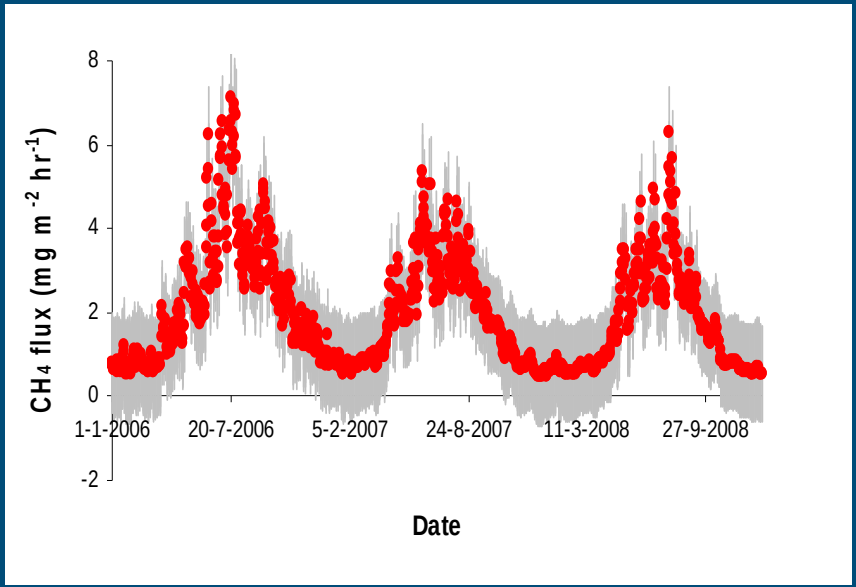
Schrier et al., in prep

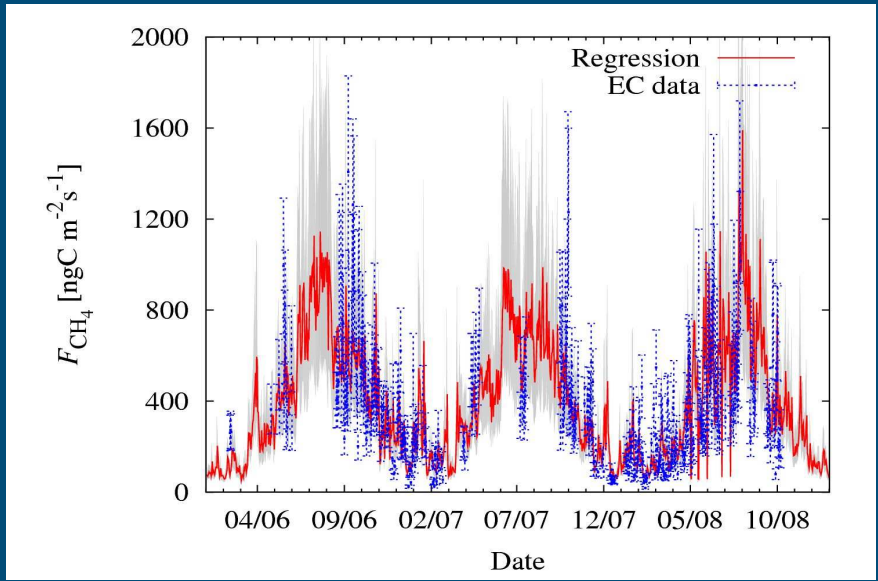
CO2 balance



Veenendaal et al., 2007; Hendriks et al., 2007

CH_4 balance





Annual terrestrial CH_4 emission in kg $CH-_4$ ha^{-1} in Oukoop in the Netherlands.

	2006	2007	2008
Eddy covariance	176 (±25%)	169 (±26%)	149 (±18%)
Static chamber	203 (±48%)	162 (±60%)	146 (±60%)

Schrier et al., submitted

Kroon et al., in prep

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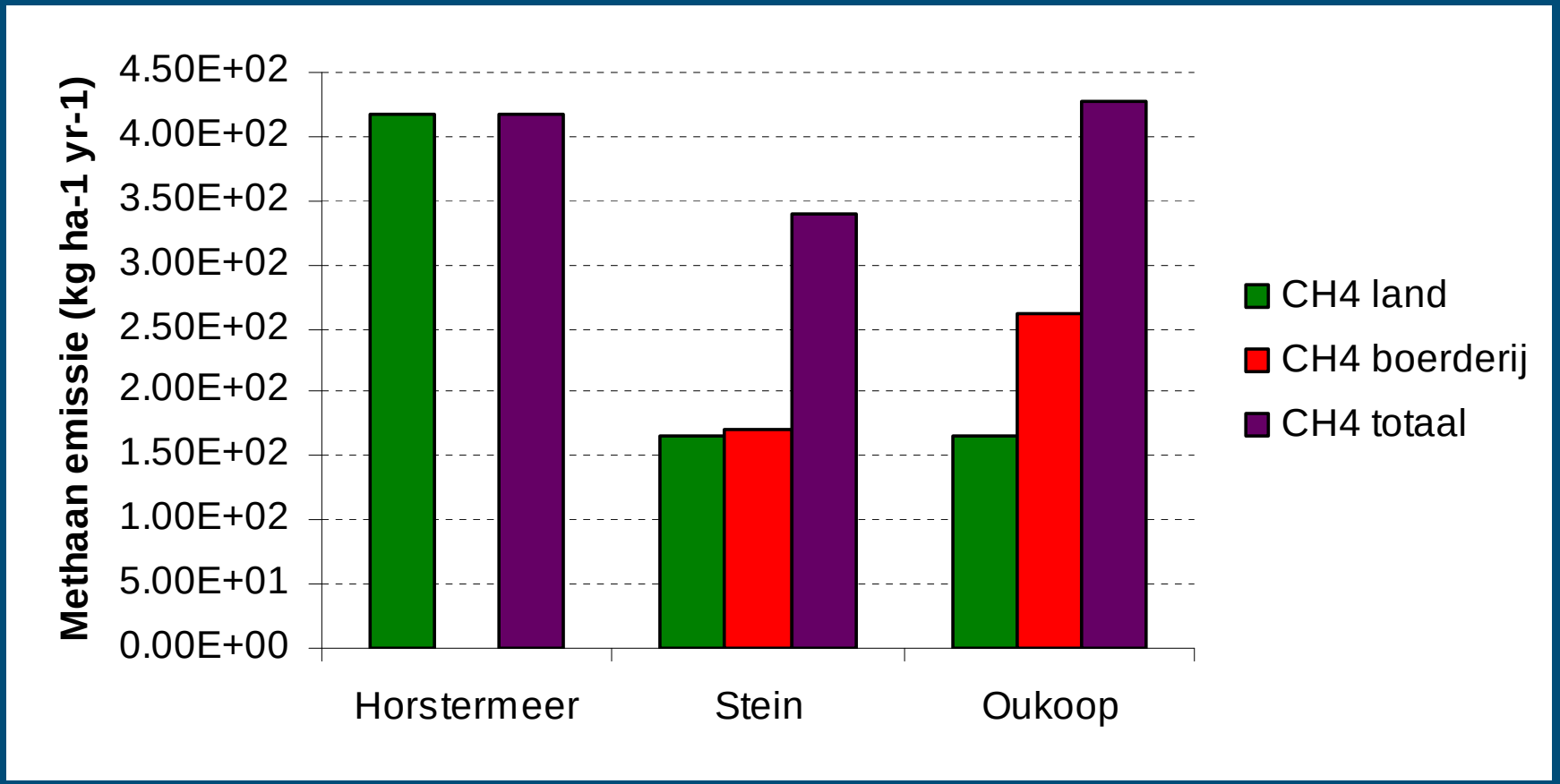
CH_4 balans inclusief 'boerderij-emissies'



Kroon et al., in prep; Schrier et al, submitted

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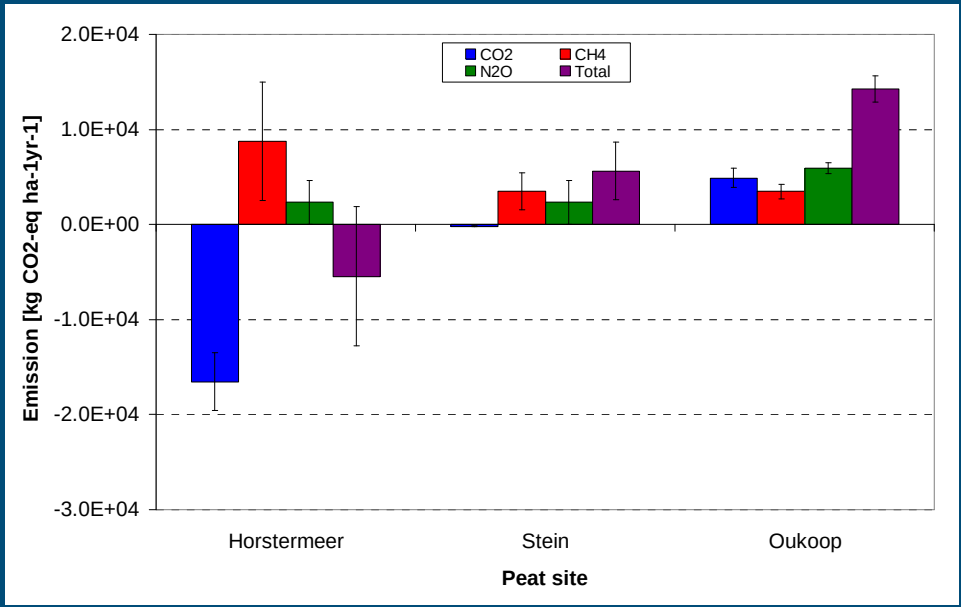
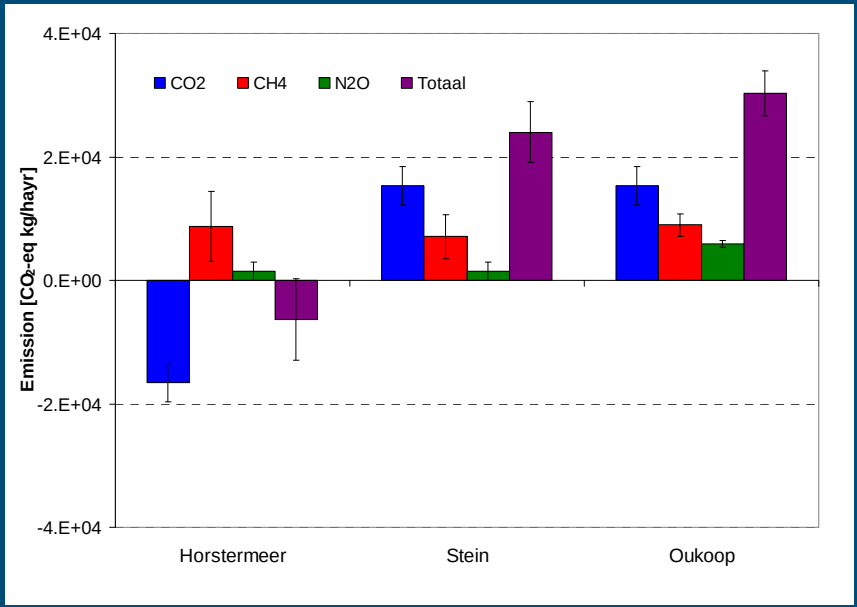
Totale broeikasgasbalans, eerste vergelijking

Alleen land-emissies



Totale emissies, inclusief management



(Velthof and Oenema, 1997; Hendriks et al., 2007; Veenendaal et al., 2007, Schrier-Uijl et al., submitted; Kroon et al., in prep)

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Conclusions

- Stratification of the landscape into landscape elements is important for up scaling emissions to larger spatial scales
- Ditches and ditch edges are methane hotspots in fen meadow ecosystems
- The studies at Reeuwijk and Horstermeer suggest that transformation of Agricultural land to Nature development will not lead to a significant increase in methane emission and will lead to a decrease of the total greenhouse gas balance

Thank you

Also thanks to collaborating partners:

ECN

VU

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