



Energy research Centre of the Netherlands

How the CH₄ balance and the total GHG balance are changing if agricultural peat lands are transformed into wetland nature

A.P. Schrier-Uijl¹

P. Kroon²

D.Hendriks⁴

E.M.Veenendaal¹

P.A. Leffelaar³

F. Berendse¹

¹ Faculty of Plant Ecology and Nature Conservation, Wageningen University, The Netherlands

² Energy Research Centre (ECN), Department of Air Quality and Climate Change, The Netherlands

³ Department of Plant Production Systems, Wageningen University, The Netherlands

⁴ Faculty of Earth and Life Sciences, Vrije Universiteit Amsterdam (VU), The Netherlands

Presented at the Early Career Scientist Workshop, 20 – 22 August, Melbourne, Australia

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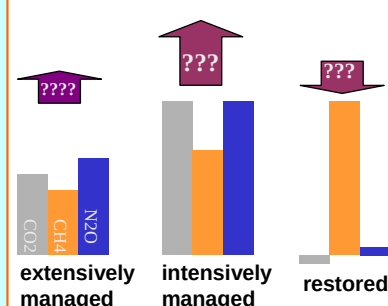
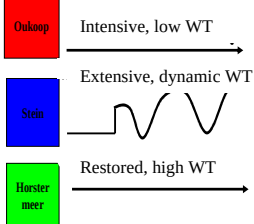
A.P. Schrier-Uijl¹, P. Kroon², D.Hendriks⁴, E.M.Veenendaal¹, P.A. Leffelaar³ and F. Berendse¹

- (1) Faculty of Plant Ecology and Nature Conservation, Wageningen University, The Netherlands
(2) Energy Research Centre (ECN), Department of Air Quality and Climate Change, The Netherlands
(3) Department of Plant Production Systems, Wageningen University, The Netherlands
(4) Faculty of Earth and Life Sciences, Vrije Universiteit Amsterdam (VU), The Netherlands

Introduction and aim

Peat oxidation in agricultural peatlands can be reduced if those peatlands are being restored by raising the water table and by reducing agricultural intensity. These measures alter the carbon cycle and probably turn greenhouse gas sources into sinks. However, large uncertainty exist of such measures on the methane (CH₄) balance and on the contribution of CH₄ in the total greenhouse gas balance. Therefore, a landscape scale experiment has started in 2005 in which three peat areas are sampled for CO₂ and CH₄ and in which agricultural intensity ranges from high to low.

Landscape Scale Experiment

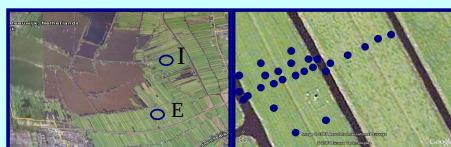


Site descriptions and Methods

The experimental fen meadows

The experimental peat areas Oukoop, Stein and Horstermeer are located in the South West of the Netherlands. The areas have a characteristic pattern with drainage ditches (21%) and meadows (79%).

Oukoop: intensively managed dairy farm area
Stein: extensively managed meadow bird area
Horstermeer: former agricultural area, semi-natural grassland



The intensively managed dairy farm area (I) and the extensively managed area (E)
Gas sampling design with fixed bases in the different landscape elements

Chamber measurements of CH₄ and CO₂ were performed in the three sites using the static closed dark chamber method and photo acoustic gas monitor (INNOVA) in the period 2006-2009.

Eddy covariance fluxes of CO₂ were measured in the period 2006-2009 in the three sites. EC fluxes of CH₄ were measured in the period 2006-2009 in Oukoop.

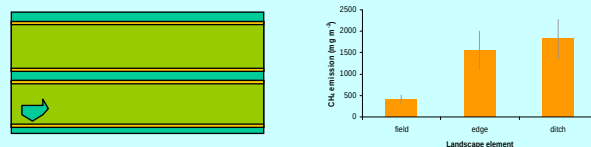
Explanatory variables were measured during each chamber measurement: soil temperature, water temperature, soil moisture content, water table, EC of ditch water, pH of ditchwater.

Meteorological measurements included wind speed, air temperature and water vapour pressure.

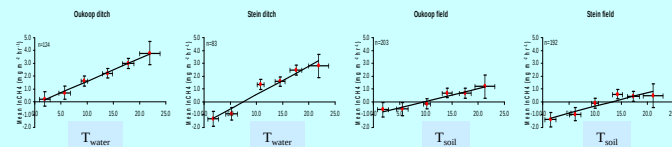
Gap filling for CO₂ consisted of the Michaelis-Menten procedure for day time data and the Lloyd & Taylor procedure for night time data. For CH₄ regression models based on temperature are used.

Results

- Ditches and bordering edges are methane hotspots in all three areas



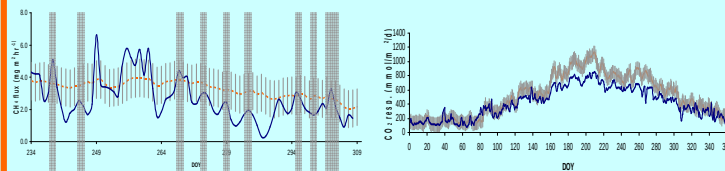
- Temperature is the best explanatory variable for CO₂ and CH₄ emissions



- Upscaled chamber based regression models (•••) agree well with the eddy covariance fluxes (—) in the same area for CO₂ and CH₄

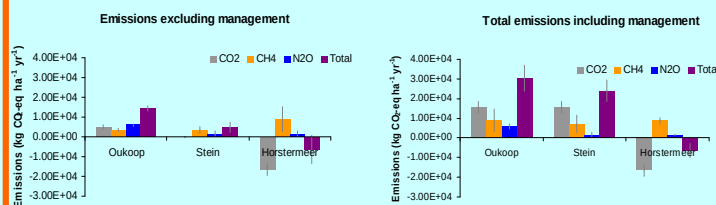
$$\text{Model: } \ln(F_{\text{CH}_4}) = a + bT$$

$$\text{Model: } R = R_{10} \times e^{E_0 \left(\frac{1}{(283.15-T_0)} - \frac{1}{(T-T_0)} \right)}$$



Comparison of modeled emission rates and EC measurements over three months for CH₄ (left) and one year for CO₂ (right). The models are based on soil and water temperature. Grey bars in the left fig. are days that wind speed exceeded 5 m s⁻¹

- The total greenhouse gas balance for the three areas



Conclusions

- Ditches and bordering edges are methane hotspots
- Soil and water temperatures are the best explanatory variable for CO₂ and CH₄ emissions
- CO₂ and CH₄ emissions measured by EC and chamber based regression models agreed well (R² >0.7) with ~16% higher cumulative emissions measured by chambers for both gases.
- Our study so far shows that transformation of agricultural land to nature development will not lead to a significant increase in CH₄ emission, and will turn CO₂ sources into CO₂ sinks.

