climate changes spatial planning

WAGENINGEN UNIVERSITY
ENVIRONMENTAL SCIENCES

How the CH_4 balance and the total GHG balance are changing if agricultural peat lands are transformed into wetland nature

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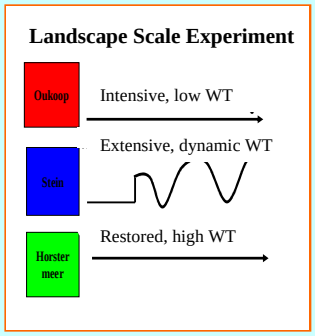
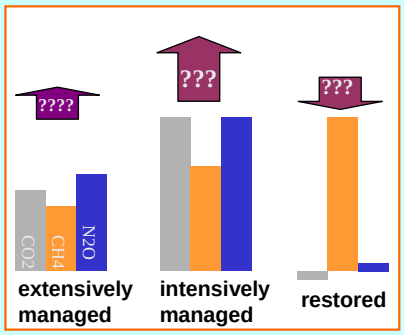
Introduction and aim

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 (CH_4) balance and on the contribution of CH_4 in the total greenhouse gas balance. Therefore, a landscape scale experiment has started in 2005 in which three peat areas are sampled for CO_2 and CH_4 and in which agricultural intensity ranges from high to low.



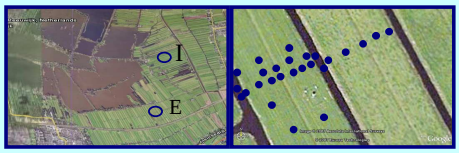


Site descriptions and Methods

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 CH_4 and CO_2 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 CO_2 were measured in the period 2006-2009 in the three sites. EC fluxes of CH_4 were measured in the period 2006-2009 in Oukoop.

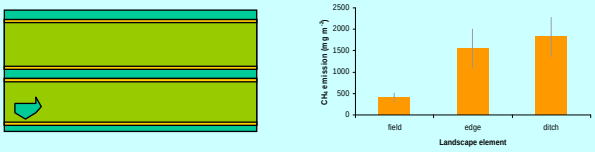
Explanatory variables were measured during each chamber measurement: soil temperature, water temperature, soil moisture content, water table, EC of ditch water, pH of ditchwater.

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

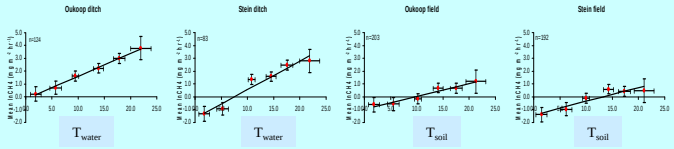
Gap filling for CO_2 consisted of the Michaelis-Menten procedure for day time data and the Lloyd & Taylor procedure for night time data. For CH_4 regression models based on temperature are used.

Results

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



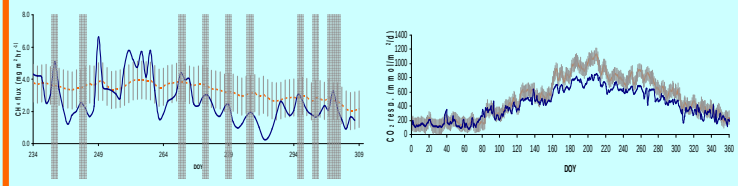
•Temperature is the best explanatory variable for CO_2 and CH_4 emissions



•Upscaled chamber based regression models (···) agree well with the eddy covariance fluxes (—) in the same area for CO_2 and CH_4

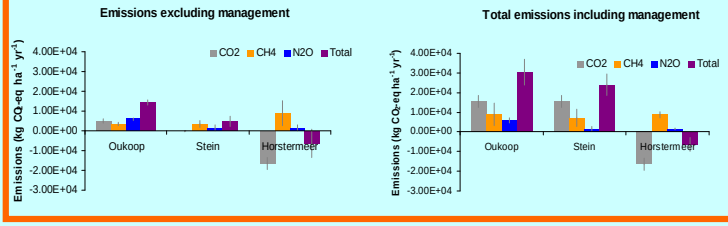
$$Model: \ln(F_{CH4}) = a + bT$$

$$Model: R = R_{10} \times e^{E0\left(\frac{1}{(283.15-T0)} - \frac{1}{(T-To)}\right)}$$



Comparison of modeled emission rates and EC measurements over three months for CH_4 (left) and one year for CO_2 (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 CO_2 and CH_4 emissions
- CO_2 and CH4 emissions measured by EC and chamber based regression models agreed well (R^2 >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 CH_4 emission, and will turn CO_2 sources into CO_2 sinks.

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