Water in a Changing Climate – Progress in Land-Atmosphere Interactions and Energy/Water Cycle Research

6th International Scientific Conference on the Global Energy and Water Cycle

and

2nd Integrated Land Ecosystem – Atmosphere Processes Study (iLEAPS) Science Conference

Parallel Science Conferences with Joint Sessions

Melbourne, Australia, 24-28 August 2009

PROCEEDINGS

VOLUME I

Editors: Anni Reissell, Marjut Nyman, Miia Vesala, Tyyne Viisanen

MOLTS and in-situ data but it also provides information on the sub-grid scale variability of the surface fields in the region. Given that the MOLTS is effective model grid data and not point-like like the in-situ data this information can be used to validate direct comparison. The selected surface fields represent a range in their sensitivity to the horizontal scales at which they are sampled, with temperature and pressure showing minimal differences from the large scale and precipitation showing the most local variability. Windspeed showed some sensitivity to topography as expected. The comparison of surface pressure required the use of a separate height correction for each location and MOLTS but otherwise the data was uncorrected. In a couple of cases the MOLTS points were over sea instead of land which clearly caused some problems in the surface property parameterization. In the case of the Equatorial Island site whilst the MOLTS points are over ocean the surface fields tend to lack the island's orographic effects.

To facilitate the use of wavelet time series techniques it was necessary to fill in as much of the missing data as possible. Data requiring filling of more than 3 days data were ignored. The comprehensiveness of the combined in-situ and MOLTS enabled a number of data imputation techniques to be tested and allowed an estimate of the robustness of the results to be obtained. Wavelet spectra and wavelet correlations were calculated for each of the variables and models. A selection of these will be discussed.

HOW THE METHANE BALANCE CHANGES IF AGRICULTURAL PEATLANDS ARE TRANSFORMED INTO WETLAND NATURE AND HOW THIS TRANSFORMATION INFLUENCES THE TOTAL CARBON BALANCE - CONTRIBUTION TO COST ACTION ES0804

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Large parts of the peatlands in Atlantic Europe are intensively managed. In the Netherlands Eutrophic peatlands have been drained for centuries and in the last 50 years peatlands have been drained even more deeply to make modern agriculture possible. The resulting peat oxidation makes that these peatlands are major CO_2 sources (Schothorst, 1977; Langeveld et al., 1997; Veenendaal et al., 2007). Burgerhart (2001) and Van den Bos (2003) have suggested that peat oxidation can be reduced if agricultural peatlands are transformed into wetland nature 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 carbon balance.

A landscape scale experiment has started in 2005 in which three areas are chosen and in which agricultural intensity ranges from high to low. The effects of transformation of intensively managed peatlands into wetland nature on the carbon balance, and more specifically on the CH_4 balance have been studied for more than three years.

The research areas Oukoop and Stein are located in the west of the Netherlands. Both areas have peaty soils with clay in the upper 30 cm. The areas have a characteristic pattern with drainage ditches (21% of the area) and meadows (79%).

The Stein area is under less intensive management as the area is now being managed as a bird protection area. Management consists of mowing 2 times a year. The mean highest GWT is 15 cm below the surface, and the mean lowest GWT is 45 cm below the surface.

The Oukoop area is an intensively managed dairy farm area. Management consists of application of manure and fertilizer 5 times a year and mowing about 4 times a year. The mean highest GWT is 25 cm below surface and the mean lowest GWT is 55 cm below surface.

The Horstermeer area is located in the central part of the Netherlands on former agricultural land. The research site has been taken out of agricultural production more than 10 years ago, and has developed into semi-natural grassland. Management consists only of regulation of the ditch water table.

Gas flux measurements were performed in the areas by (1) using a closed chamber method for CO_2 and CH_4 every month up to every two weeks in the period 2005-2009 and 2) the eddy covariance method for CO_2 (2005-2009). For continuous measurements of CH_4 in the Oukoop site, we used the eddy covariance dataset of Kroon et al. (2007). Wind speed, air temperature and water vapour pressure were monitored in the three sites and also temperature (water/soil), soil moisture and water level were measured. Since the spring of 2008 we also performed pH and EC measurements in the ditches.

We first focused on spatial and seasonal variability of CH_4 and CO_2 emissions in peat meadows and on the upscaling of fluxes measured by chambers to larger spatial scales and larger temporal scales. By using using step-wise multiple linear regression analysis (case-wise elimination of variables) and by taking into account the landscape elements that contribute differently to the CH_4 balance, fluxes measured by the chambers were upscaled to landscape scale. The reliability of this upscaling procedure was tested by comparing the upscaled CO_2 and CH_4 flux measurements to landscape scale CO_2 and CH_4 fluxes measured by eddy covariance systems in the same site. Uncertainties per landscape element where estimated with a temperature dependent approach. Annual CH_4 balances were estimated for the areas and were compared.

Ditches and bordering edges were emission hotspots in the landscape and appeared to be very important contributors to the CH_4 balance in the three sites. Former studies often did not take fluxes from drainage ditches into account, which can cause up to 50% underestimation of the CH_4 flux in peat areas as such.

A clear seasonal pattern for CH_4 emissions existed and temperature was the most important driving variable of CH_4 and CO_2 emission (Figure 1).

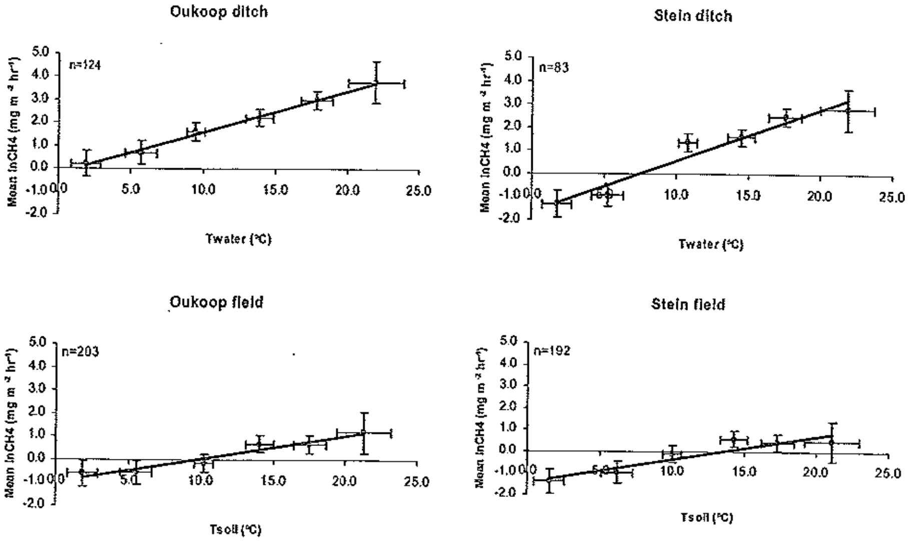

Fig. 1. The dependency of ln transformed CH_4 fluxes (mg m^{-2} hr^{-1}) on temperature (^0C) in ditches and fields in Oukoop (left) and Stein (right). Temperatures are pooled. The x-error bars represent the standard deviation of the temperature per class and the y-error bars represent the standard deviation of the $lnCH_4$ flux.

After correction for temperature, no difference between day and night CH_4 fluxes occurred and regressions with temperature as explanatory variable were used to scale CH_4 and CO_2 fluxes up to landscape scale. To test the reliability of the models that were used for upscaling, cumulative fluxes based on chamber measurements were compared to the cumulative fluxes measured by eddy covariance (see Figure 2 for CH_4). The difference in cumulative fluxes was 16.5% for CH_4 and 17% for CO_2 over a period of three months and one year, respectively.

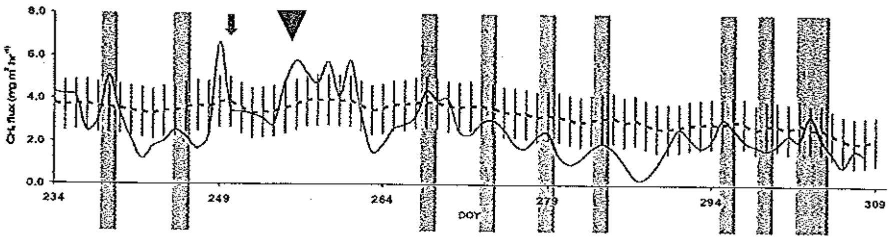

Fig. 2. Time series of measured (red solid line) and modeled (blue dashed line) daily averaged CH_4 fluxes during the period 21 August to 5 November, 2006. The uncertainty band around the dotted line represents plus and minus one standard error for mean prediction, based on the regression analyses, and calculated for each day. The large bars represent days on which wind velocity exceeded 5 m s^{-1}; the brown large arrow represents a manure application event and the green small arrow represents a mowing event.

Terrestrial annual CH_4 fluxes ranged from 146.3 to 203.3 kg ha^{-1} in Oukoop and from 156.7 to 180.2 kg ha^{-1} in Stein of which 46% and 43% of the emissions was from ditches and bordering edges (Table 1). Terrestrial CH_4 fluxes of the Horstermeer site were the highest in all years but if farm based emissions were taken into account, CH_4 emissions in Oukoop did not differ significantly from the Horstermeer CH_4 emissions.

Table 1. Mean soil temperatures, water temperatures and temperature based estimates of annual terrestrial methane emissions (kg CH4 ha⁻¹) for the intensively (Oukoop) and extensively (Stein) managed sites.

	2006	2007	2008
Tsoil_mean	10.5	10.5	10.4
Twater_mean	10.9	12.6	12.6
Modeled CH_4 flux Oukoop	203.3 (±48%)	162.2 (±60%)	146.3 (±60%)
Modeled CH_4 flux Stein	156.7 (±63%)	180.2 (±54%)	162.9 (±59%)

When comparing the total CH_4 and CO_2 balances of the intensively managed and extensively managed areas to the CH_4 and CO_2 balance of the Horstermeer site, the studies suggest so far 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.

A PILOT ASSESSMENT OF BIOLOGICAL AND GEOCHEMICAL COMPONENTS OF ECOSYSTEM-SCALE CO_2 EXCHANGE

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The eddy covariance micrometeorological technique is one of the most important tools for understanding and monitoring the global carbon cycle [*Matross, et al.*, 2006]. The international micrometeorological network of eddy flux towers (FLUXNET) provides direct ecosystem measurements of carbon dioxide, water vapour and energy flux densities [*Baldocchi, et al.*, 2001] and is a critical source of information for the validation and improvement of models used to study regional and global carbon cycles [*Friend, et al.*, 2007]. In these investigations, the net CO_2 flux has generally been interpreted as a biological flux (photosynthesis and respiration) neglecting carbonaceous rock dissolution or weathering processes. This net CO_2 flux is commonly termed Net Ecosystem Exchange (NEE) and separated into in Gross Primary Production (GPP) and Total Ecosystem Respiration (TER) components using ecophysiological models [*Falge, et al.*, 2001]. In this context, the net flux of CO_2 associated with carbonate reactions is assumed negligible when compared to the gross biological flux, and therefore not taken into account in ecosystem-scale carbon cycle research.

Evidence from two ecosystems overlying carbonaceous substrates contradicts the common, unstated hypothesis that surface-atmosphere exchange of CO_2 in terrestrial ecosystems always can be interpreted purely in terms of biological processes of photosynthesis and respiration. A combination of micrometeorological and