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CO_2 and CH_4 flux measurements in an abandoned peat meadow in the Netherlands

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Background and Aim

Our research aims to assess the effects of changing environment and management practices on the greenhouse gas fluxes from peat meadow areas. The objectives are:

1. To asses the possibility of water level manipulation as a management tool for GHG fluxes from peat meadow areas;

2. To understand the controlling mechanisms of GHG fluxes (CO_2, CH_4, N_2O) emissions in fen meadows;

3. To improve the estimates of the contribution of the fen meadow areas to overall land use GHG emissions from the Netherlands.

The Horstermeer site is located on former agricultural land in a drained natural lake. The research site has been taken out of agricultural production more than 10 years ago, and has developed into semi-natural grassland. The soil consists of peat underlain by Pleistocene sands and is overlain with organic-rich lake deposits. The area is subject to strong groundwater seepage from surrounding lake areas and Pleistocene ice pushed ridges. After the site has been taken out of agricultural production, the ditch water table has been raised to approximately 10 cm below the land surface.

Research methods and Instrumentation

At the fieldwork location eddy-correlation measurements are performed for CO_2. Flux chamber measurements are performed for CO_2, N_2O and CH_4: 200 measurements were performed on land and 4 on water. Furthermore, qualitative and quantitative hydrological measurements are performed as well as vegetation and soil analysis. Eddy

correlation measurements of CO_2 fluxes and hydrological measurements started in January 2004. Flux chamber measurements started in 2003 for CO_2 and CH_4 in 2003 and in 2004 for N_20. Other analysis started in 2005.

Conclusions

Considering the energy balance closure, which is 96%, the quality of the eddy-correlation data is good. A strong correlation between soil temperature and respiration is found, which forms the basis of the flux partitioning. Respiration is shown to be independent of the level of friction velocity. Net yearly uptake of CO_2 was 276 gC/m^2 in 2004, and 301 gC/m^2 in 2005. Further calculations for 2005 resulted in a total CO_2 respiration of 2585 gC/m^2 and a total CO_2 uptake of 2886 gC/m_2.

Temperature determines most of the temporal variations while small variations in hydrology, soil and vegetation determine spatial variability. The average CH_4 flux on land over the measurement period was 19 gC/m^2. When considered as CO_2 equivalents, the net CO_2 flux from land is -1058 eq./m2 while the yearly of CH_4 flux from land is 584 $eq./m^2$ (gCH_4/m^2 multiplied by 23, which is the global warming potential for methane with a time horizon of 100 years).