Exceptionally high summer methane emissions from a boreal peatland ecosystem in the Republic of Komi, Russia

Ulrike Wolf1, H. F. Jungkunst1, I. Forbrich2, J. Schneider2, P. Schreiber2,3, M. Wilmking2, I. Kutzbach2,3

1) Department of Landscape Ecology, University of Göttingen, Germany (uli-wolf@gmx.de), 2) Institute of Botany and Landscape Ecology, University of Greifswald, Germany, 3) Institute of Soil Science, University of Hamburg, Germany

Motivation

Peatlands of European Russia play a crucial role in the European methane balance as vast parts are covered by peatlands.

Methane emissions in peatlands are controlled by topography, soil temperature, water table and plant cover.

Therefore, it was expected that the CH₄ fluxes between the atmosphere and the different microrelief positions represented by hummocks, lawns and flarks differ.

Results

In total, CH₄ emissions were exceptionally high. The maximal value was 1614 mg m⁻² d⁻¹, several peaks above 1000 mg m⁻² d⁻¹ occurred on flarks and lawns. The mean value of all measurements is at 316 mg m⁻² d⁻¹. The values exceed by far the average of 5-80 mg CH₄ m⁻² d⁻¹ for the boreal zone (Blodau 2002).

Significant differences between the three different relief types (hummock, lawn, flank) were found.

Methane emissions were lowest from hummocks, highest from flarks. A higher water table leads to higher fluxes. Additionally a significant correlation of increasing fluxes and an increasing aerenchymatous leaf area index (LAIₜₐₑ) could be determined.

Method

Methane flux measurements were carried out with air ventilated opaque aluminium chambers (60 x 60 x 20 cm). 6 air samples were taken in an interval of 3 or 4 minutes.

Measurements were made from mid-June until end of September 2008. Fluxes were calculated from 4 out of 6 measurement points after a linear regression.

Soil water was sampled in four depths below the water table with stainless steel tubes and plastic syringes.

The gas samples were analyzed with a FID gas chromatograph.

Discussion & Conclusion

• area proportion and individual flux rates of the small-scale differentiation of topography (hummocks, lawns and flarks) must be considered for upscaling and estimation of total methane release of the Ust-Pojeg peatland.

• differences in CH₄ emissions among the plot types were mainly explained by the water table position and the LAIₜₑ.

• seasonality of CH₄ fluxes is triggered by soil temperature; yet the mean level of the water table must be kept within a certain depth to enable modelling.

• Ust-Pojeg peatland is a strong methane emitter, as it lies within the area of highest peatland distribution throughout Europe, more detailed studies are required to give more reliable estimates of Europe’s methane balance.