EMS Annual Meeting Abstracts
Vol. 15, EMS2018-522, 2018

Carbon dioxide and methane turbulent fluxes for mid-European mire – results of 5-year EC measurements in Biebrza National Park

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As one of the biggest store of global soil carbon, wetlands play a significant role in global cycle of greenhouse gases. Still, the information on multi-annual variability of the exchange of major greenhouse gases (carbon dioxide and methane) between atmosphere and ecosystem is limited for mid-European mires. The Biebrza National Park (northeastern Poland) belongs to the biggest coherent lowland wetland area in central Europe, where wetlands cover an area of over 250 km2. Here, we present the results of 5-year (2013-2017) continuous eddy-covariance measurements of turbulent fluxes of methane and carbon dioxide and the energy balance components from site located in the central basin of Biebrza valley on the large, flat surface near to the village Kopytkowo (53°35'30.8"N, 22°53'32.4"E, 110 m a.s.l.). The surroundings are characterized by a relatively homogenous mixture of reeds, sedges and rushes characteristic for the Biebrza wetlands.

The measurement system consisted of fast and slow response parts. The eddy-covariance measurements at a rate of 10 Hz were performed using open-path fast response sensors: a sonic anemometer (81000, R.M.Young) and two gas analyzers (Li7500 for CO2/H2O and Li7700 for CH4) mounted at the height of 3.7 m. The eddy-covariance system was complemented by slow-respond measurements including: standard meteorological parameters, components of radiation balance, photosynthetically active radiation (up and down), heat flux to the ground, volumetric water content in the ground and ground water level. To achieve a comparison with other studies, the fluxes were calculated with the EddyPro software (standard block averaging on 1-h basis), but 3 additional stationarity test were used to get a high quality data.

The results show that Biebrza mires exhibit a high sensitivity to the climatic condition mainly to the water table level. In year 2013, which was relatively wet in the long-term perspective, the studied wetland was a significant sink of CO_2 with annual uptake reaching almost 1000 gCO_2 m^{-2} y^{-1} whereas in extremely dry year 2015 we recorded net CO_2 release about 500 gCO_2 m^{-2} y^{-1}. The annual methane release, was on the level of 29 gCH4 m^{-2} y^{-1} in 2013, trough 20 gCH4 m^{-2} y^{-1} in 2014, and dropped below 5 gCH4 m^{-2} y^{-1} in dry years. Moreover, it is worth to mention than only little differences between wet and dry years were recorded in latent heat flux (evapotranspiration).

Acknowledgements: Funding for this research was provided by the Polish National Centre of the Science under project UMO-2015/17/B/ST10/02187