Geophysical Research Abstracts
Vol. 13, EGU2011-8771, 2011
EGU General Assembly 2011

Impact of dry-wet cycle and flooding on redox dynamics and carbon cycling in a northern fen

Cristian Estop (1), Klaus-Holger Knorr (1), Christian Blodau (1,2)

(1) Limnological Research Station, Department of Hydrology, University of Bayreuth, Bayreuth, Germany (cristian.estop@uni-bayreuth.de / +49 (0)921 55 2366), (2) School of Environmental Sciences, University of Guelph, Guelph, Canada (cblodau@uoguelph.ca)

Peatlands are quantitatively important carbon-storing terrestrial ecosystems where peat develops due to the rate of C input (organic matter as litter) surpassing that of C output (gas efflux and leaching) as plant biomass decomposes. High water contents are an important factor controlling such C balance in these soils since water does not limit plant growth while keeping peat in a reduced state thus lowering peat degradation rate. A predicted effect of current climate change is the potential alteration in the hydrological regime due to extreme rain events, extended dry periods as well as floodings. Thus, water table (WT) fluctuations are expected to influence redox processes and carbon cycling in peat soils.

We investigated redox dynamics, respiration and transport processes in peat profiles during manipulation of WT at ecosystem scale in a small fen located in a forested area of North Bavaria (Germany) and compared them to natural WT fluctuations. The experimental design consists on two treatments; WT was manipulated in one and it was not in the other. Three spatially high resolved peat profiles were investigated during 2 consecutive seasons for each treatment. An extended drought and subsequent rewetting during the first season and a flooding event during the second one were carried out. Gas (O_2, CO_2, CH_4) and pore water (redox sensitive species) concentrations as well as soil moisture and temperature allowed gaining insight into spatio-temporal gradients related to WT fluctuations and seasonality.

Our results indicate that dry events take place seasonally leading to shifts in the peat redox state. As peat becomes drier when WT drops, the diffusive transport is affected leading to oxygen penetration, methanogenesis reduction or inhibition, loss of stored CO_2 and suppression of Fe(III) and sulphate reduction processes in the profile. This pattern is magnified as observed from the reinforced drying in the first season and it is inverted as WT recovers and is kept high. Calculations and peat depth incubations indicate that most CO_2 and CH_4 production takes place in the upper peat layers thus resting importance to the intensity of the WT drop regarding CO_2 emissions in this site. Nevertheless, the intensity of the WT drop is important regarding the renewal of the electron acceptor pool, greater due to the reinforced drying. The long lag time phase observed for CH_4 concentrations recovery after the dry event indicates that no CH_4 emissions are expected in this system if such intense dry events seasonally occur.