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A possible response to climate extremes of fluxes and concentrations of CO_2 and CH_4 in northern fens.

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As long term sinks of atmospheric CO_2 and persistent sources of CH_4, peatlands are important biospheric feedback components of the global carbon cycle. Climate predictions show changes in the temporal pattern of precipitation, resulting in longer dry periods and more extreme precipitation events. Hence water level fluctuations may show an increase at both seasonal and shorter term time scales. The speed of recovery of both methanogens and methanotrophs after periods of low water levels is an important factor in predicting the lag in the reactivation of methane production. Unfortunately, high-resolution measurements of carbon mineralization rates under dynamic conditions and in undisturbed soil samples are sparse.

The objective of this study is to determine the effect of drought followed by extreme precipitations events and the presence of vegetation on the sub-surface production and flux of CO_2 and CH_4 in undisturbed peat samples from a northern fen.

We incubated 3 mesocosms (60 cm diameter, 60 cm depth), control, vegetated and non-vegetated treatment, at 15˚C and 12 hours of light per day. The cores were allowed to settle for 4 weeks after sampling. Then the water level was raised to 10 cm below soil surface by applying artificial rain. After 8 weeks, a drought period of 40 days was started, during which the water level fell to $\sim$ 40 cm below s.s. Subsequently, the cores were rewetted by flooding (20 mm/d) until the water level was around 10 cm below s.s again. The control was not subject to the drying/rewetting cycle, which was applied to the treatments. Subsurface CO_2 and CH_4 pools were monitored using pore water peepers and gas samplers. The gas samplers allowed to obtain dissolved CO_2 and CH_4 concentrations in the unsaturated zone. Fluxes of CO_2 and CH_4 were measured

using the static chamber technique. The water level was measured in piezometers and volumetric water content was monitored using TDR sensors.

Our first results show that raising the water level to 10 cm below s.s after 4 weeks caused a build-up of dissolved subsurface CO_2 and CH_4. At the end of the flooding, concentrations of subsurface CO_2 and CH_4 had doubled compared to shortly after raising the water level. In all cores, the production of CH_4 built up slower than of CO_2. The presence of methane above the water table indicates the importance of root exudates. Shortly after the water level rise, an increase in the soil CO_2 flux and photosynthesis, measurable in the control and vegetated treatment occurred. A slow increase of soil CH_4 flux was observed from day 60. In the gas samplers the effect of drying out was clearly visible. The concentrations of CO_2 and CH_4 quickly decreased with depth following the water table decline. CH_4 became depleted in the upper 40 cm. After drying out, photosynthesis in the vegetated treatment remained stable and the soil CO_2 and CH_4 flux decreased. The soil CO_2 flux in the non-vegetated treatment showed large fluctuations to drying out whilst soil CH_4flux showed a major decrease.