Geophysical Research Abstracts
Vol. 20, EGU2018-19139, 2018
EGU General Assembly 2018


# Elevated tropospheric ozone enhances carbon storage in temperate peatland mesocosms

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Tropospheric ozone already poses a significant threat to crop yield and forest productivity of sensitive species at current levels in Europe, while further increases in northern hemisphere background levels are predicted. The impacts of ozone on peatlands, especially belowground, are poorly understood. Risk assessment of ozone impacts on peatlands is essential, because peatlands are a significant store of carbon (C) and an important source of methane ($CH_4$). The aims of this study were to assess the effects of elevated ozone on $CO_2$ and $CH_4$ exchange in a temperate peatland.

Mesocosms from a wet heath (Isle of Skye, Scotland) with vegetation dominated by the sedge *Schoenus nigricans* and the peat moss *Sphagnum papillosum* were exposed for 2.5 years to control and elevated levels of ozone in open-top chambers. The control treatment received non-filtered air, whereas the elevated ozone treatments consisted of non-filtered air (NFA) plus 10, 25 and 35/10 ppb. The highest ozone treatment had a target concentration of NFA+35 ppb for 8 hours during the summer and NFA + 10 ppb for 8h per day during winter. In the two intermediate treatments, ozone was elevated for 24h per day in both summer and winter. Methane and $CO_2$ (net ecosystem exchange, ecosystem respiration and gross photosynthesis) flux measurements were carried out every 4-6 weeks during the entire experiment, whilst during the last growing season also high-frequency (hourly) measurements of $CH_4$ emission and net ecosystem exchange were determined.

Methane emissions were reduced by elevated ozone from the end of the first growing season onwards. This effect was not related to reduced plant-derived carbon inputs, but rather appeared to be controlled by lower pore water ammonium concentrations. Ecosystem respiration was enhanced by elevated ozone from the second growing season, while gross photosynthesis was increased by elevated ozone from the onset of the experiment. The former was largely caused by enhanced respiration of the sedges at elevated ozone. Clear diurnal patterns in $CH_4$ emission were observed, with highest fluxes during the night. As expected, net ecosystem exchange showed clear diurnal patterns with net $CO_2$ uptake in the daytime and net $CO_2$ release to the atmosphere during the night. The impacts of the high-frequency measurements on the $CH_4$, $CO_2$ and C budgets of these mesocosms will be discussed. Overall, elevated ozone (NFA +35/10 ppb) considerably increased net C storage in this temperate peatland. As large areas of northern hemisphere temperate ecosystems experience such high $O_3$ exposures in spring and summer, our results imply that temperate $CH_4$emissions across the northern hemisphere are already significantly reduced by $O_3$, and this effect may become greater in future in regions (such as Asia) where precursor emissions of $O_3$ are predicted to increase.