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Combined effects of drought, temperature and CO2 on GHG emissions from temperate shrub-land

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Background Increased atmospheric concentrations of fossil and biogenic derived greenhouse gases CO_2, CH_4 and N_2O affects global temperature and precipitation patterns. Such climatic and environmental changes will alone and in combination have strong effects on the terrestrial ecosystems with consequences for their future structure and functions.

In 2005 a project focusing on biological effects of climate change (Mikkelsen et al., 2007) was initiated with the aim to improve our understanding of how climatic and environmental changes in concert will affect biological processes in terrestrial ecosystems. One task is the examination of biosphere-atmosphere exchange of biogenic GHGs under future climatic conditions.

Methods. The study site is on a shrubland dominated by the evergreen *Calluna vulgaris* and grasses *Deschampsia flexuosa*. Soil is characterized by a sandy moraine. The fluxes of CO_2, CH_4, and N_2O are measured in a full factorial design with CO_2, temperature and drought as treatment variables. Analysis of soil samples for potential denitrification, nitrous oxide reductase activity and presence of denitrifying enzymes (*nirK, nirS* and *nosZ)* is conducted at regular intervals.

Results. Observations on GHGs were initiated in June 2006. Generally emission rates of N_2O were small (<10 µg N^{-2} h^{-1}) and much scattered. A trend in data suggests reduced N_2O emissions as well as increased CH_4 oxidation in response to particularly the drought treatment. Increased temperature also seems to reduce N_2O emissions, but when combined with elevated CO_2 the results do suggest that both drought as well as temperature effects are alleviated by the CO_2. In the 2nd growing season the environmental manipulations did not affect N_2O emissions, however, peak emission rates were observed after heavy rainfalls.

Potential denitrification activity is significant in the top soil (30-300 ng N g^{-1} h^{-1}) Nitrous oxide reductase activity is negligible in this community suggesting that N_2O is the final product from denitrification. PCR-amplification of the *nirK, nirS* and *nosZ* gene fragments has so far not been successful.

References.

Mikkelsen, T. N. et al. 2007 Experimental design of multifactor climate change experiments with elevated CO_2, warming and drought: the CLIMAITE project. Functional Ecology 0(0); doi: 10.1111/j.1365-2435.2007.01362.x

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