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Manipulation of temperature and precipitation alter CO2 and N2O fluxes from an arable soil

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Carbon cycling in terrestrial ecosystems provides a feedback mechanism to climate change by releasing or sequestering additional atmospheric CO2. However, the response of terrestrial carbon cycling to the interactive effects of a changing temperature and precipitation regime is still unclear. A field experiment was established in summer 2008 to manipulate soil temperature and precipitation on an arable field. The plots are covered by roofs, which are closed with a UV-transparent greenhouse film during summer. Roof control plots (without roof) were additionally established to account for the impact of the roof on the micro-environmental conditions (only Ambient precipitation). Each treatment is replicated four times. Soil temperature is increased by 2.5°C in 4 cm depth using heating cables, which are placed on the surface. Temperature probes in 4 cm depth are connected to a datalogger, which controls the electricity supply of the heating system. Each ambient and elevated temperature plot has a size of 4 x 1 m^2 and is divided into 4 subplots according to the following precipitation manipulation treatments: a) ambient, b) precipitation amount decreased by 25% during summer and increased by 25% during winter, c) drought periods increased by 50% during summer, d) combination of b and c. Each subplot is surrounded by a PVC barrier to a depth of 0.5 m to avoid lateral water movement between subplots and the surrounding soil. The experimental plots were planted with spring wheat (Triticum aestivum) in 2009. Plants were harvested in August and aboveground biomass was determined. We measured the CO2 and N2O fluxes weekly using the closed chamber method. After mid of October, the closure time was increased from 30 to 60 min to account for low gas fluxes. First results indicate that the manipulation of climatic factors (soil temperature, precipitation) induced short-term effects one year after start of the field experiment. Aboveground wheat biomass was increased by elevated soil temperature (+14%). This was accompanied by an increase in the CO2 and N2O flux . Temperature elevation increased the cumulative CO2 production by 11% for the period 04.03.09 to 12.08.09, whereas the cumulative N2O production was increased by 16% for the same period. In contrast, the reduction in summer precipitation amount probably induced water limitation, which could be responsible for the lower aboveground plant biomass (-7%). Similarly, CO2 emissions tended to be reduced by the reduction of the precipitation amount. During the next months, the data set will be completed and the already existing data will be analysed in more detail. Overall, this project provides valuable information on the response of biogeochemical cycles to climate change and will give us the opportunity to study long-term effects of the climate change.