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Long-term effects of precipitation removal manipulations on soil carbon balance and exchange in a Danish heathland/grassland ecosystem

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The influence of drought on terrestrial carbon cycling has received great attention because of the increasing frequency of extreme drought events in climate scenarios. In the CLIMAITE experiment, we have exposed plots to reduced precipitation since 2006. During the first years, precipitation was only reduced for 4-6 weeks during spring/early summer. In order to increase our focus on finding thresholds for functional and structural change in the ecosystem, the experiment was redesigned towards more extreme manipulations in June 2016 using a new gradient design continuously removing 40, 50, and 66% of ambient precipitation with permanent rainout shelters.

Rates of net ecosystem exchange (NEE), ecosystem respiration (R_E) and soil respiration (Rs) are measured inside treatment plots using an LI-6400 connected to a custom-built 210L transparent chamber (for NEE) that can be darkened (for RE) as well as a 1L dark chamber (for Rs). In addition, environmental variables such as soil temperature, precipitation, soil water content and photosynthetically active radiation (PAR) are recorded continuously at the plot or site level. In addition, soil cores from the different treatments will be collected and analyzed for soil substrate (e.g. soil organic carbon) and incubated in the lab for analysis of Q_{10}. Using the observations from the field and the lab together we will develop a new multiple regression model to fit the CO_2 fluxes under severe precipitation removal treatments.

To obtain more reliable and accurate estimates of the seasonal and annual responses of soil carbon flux exchange under precipitation change scenarios, the change in soil water content and temperature, the soil substrate availability as well as the variation of the frequency and timing of precipitation events are included in the carbon flux model. The fitting of models to the observational data will reveal if functional/structural thresholds for the carbon exchange have been exceeded in the ecosystem, thus providing novel experimental and modeling evidence for such thresholds.