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Spring drought effects on carbon turnover in and above temperate grasslands

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Introduction

Conservation of grasslands carbon storage characteristics is desirable in times of climate change. But ecosystem function and species composition of temperate grasslands are likely to respond to precipitation change (IPCC). As long-time climate measurements suggest precipitation deficits in Southern German low mountain ranges mainly during spring, FORKAST project investigates local carbon cycle during artificially induces drought periods.

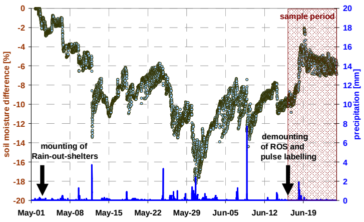

Fig.1: Induced soil moisture difference between "drought" and "normal" plots reached a value of 10% at point of labelling. 135 mm precipitation have been excluded from "drought" plots.

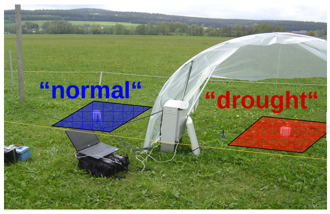

Fig.1: Experiment setup: "Normal" and "drought"-plots alternating arranged in a row (5 repetitions each). Soil temperature and moisture have been logged on both.

Pulse labelling experiment

The site "Voitsumra" is located on an extensively managed pasture 624 m a.s.l. After artificial 1000-year-drought period and demounting of the rain-out-shelters the plots have been labelled with stable isotope tracer (see Fig. 3 and 4).

Fig. 3: $^{13}CO_2$ pulse labelling chambers with thermal packs, fans and carbon/acid-reservoirs inside.

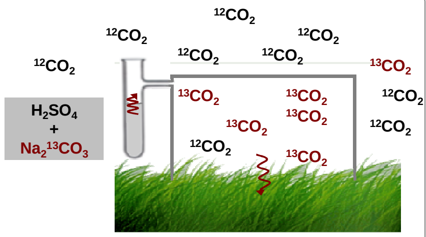

Fig. 4: Schematic illustration of $^{13}CO_2$ pulse labelling

Some preliminary results

Up to now about one-fifth of the samples has been analysed. The experiment setup worked well as a significant enrichment compared to natural abundance values could be found in all compartments. Tracer is shifted from green above-ground biomass (Fig.8) into the root system (Fig.9a/b). Roots in low depth show earlier and more enrichment before values get more and more equal. Soil samples show also an enrichment which stays constant during first five days of sampling (Fig.10a/b).

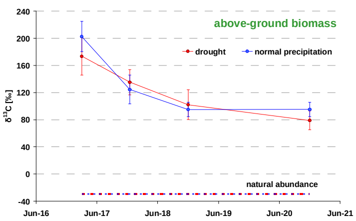

Fig.8: δ13C-values of labelled above-ground biomass compared to natural abundance value.

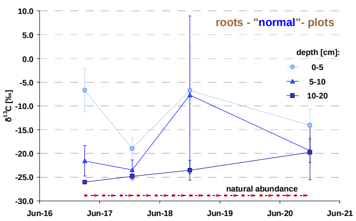

Fig.9a: δ13C-values of root system on normal plots

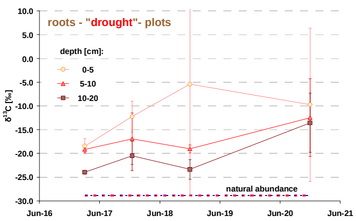

Fig.9b: δ13C-values of root system on drought plots

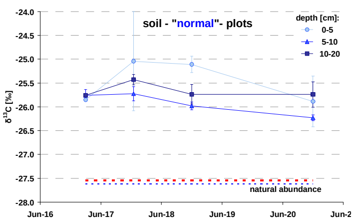

Fig.10a: δ13C-values of soil on normal plots

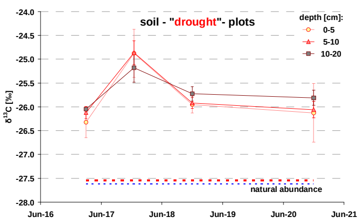

Fig.10b: δ13C-values of soil on drought plots

First results indicate that there is no difference between treated and untreated plots. This should not be assigned to spring drought effects in general. Climate measurements on our site show spring 2010 as unusual cold with high atmospheric humidity. Under those conditions vegetation dealt well with missing precipitation and less soil moisture.

Meteorological conditions

The labelling experiment was accompanied by several meteorological measurements. Decreasing temperature and rainfall events during third day of sampling have to be considered while analysing tracer translocation.

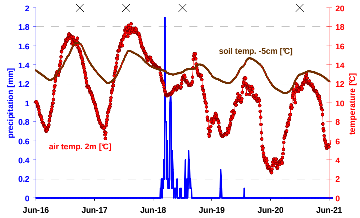

Fig.5: Soil and air temperature and precipitation during sample period. Chamber pulse labelling chambers induced no peak in soil temperature during June-16th. Crosses mark dates of sampling.

Atmospheric C-fluxes

Atmospheric CO_2 flux measurements can not provide separate fluxes from normal and drought plots, but a site specific background flux (Fig.6). After analysing all soil and plant samples we will make efforts to evaluate the influences those fluxes have on tracer translocation in biosphere and soil.

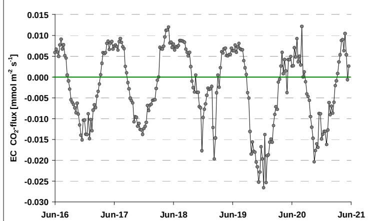

Fig.6: Eddy Covariance (EC) determined atmospheric CO_2-flux 2 m above ground. Values < 0 indicate downward fluxes (ecosystem = CO_2 sink) and vice versa.

The same will be done with the results of complex atmospheric $^{13}CO_2$-flux measurements (Fig.7).

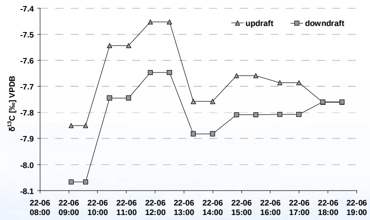

Fig.7: Atmospheric $^{13}CO_2$ measurement June-22nd

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