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Drought response of soil CO_2 emissions in current and future climate

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As climate change proceeds, extreme climatic events (ECEs) such as drought are expected to increase in intensity and in frequency, with consequences for the carbon cycle. Soil respiration (Rs) is the biggest flux of CO_2 from terrestrial ecosystems to the atmosphere. While effects of drought on Rs have been repeatedly studied, less is known how a future warmer climate under elevated CO_2 will modify drought responses. While climate warming is expected to enhance drought induced reduction in Rs, elevated CO_2 has been suggested to enhance soil respiration and slow down the drying of soils. As contribution to the ClimGrass-project we assessed Rs-dynamics during and after a drought event under ambient conditions (C0T0) and under a +3°C warming scenario with a CO_2 increase of 300ppm (C2T2). For each of the four treatments three replicate plots were equipped with an automated soil respiration system to assess high resolution Rs fluxes before, during and after drought. Our results show that Rs fluxes were generally higher in the C2T2 treatment than in C0T0 and were generally reduced during drought-treatments. All drought and post-drought effects on Rs were more pronounced in a future (C2T2) compared to a current climate. This included Rs reduction during drought and CO_2 pulses after rewetting, which led to a transient overshooting the magnitude of corresponding control-fluxes after the drought.
An in-depth analysis of soil CO_2 gradients across the soil profile will permit an understanding of the modification of soil CO_2 production and transport processes underlying the observed soil respiration dynamics.