EFFECT OF SUMMER DROUGHT ON THE COUPLING OF PHOTOSYNTHESIS AND SOIL RESPIRATION UNDER CURRENT AND FUTURE CLIMATE

Kathiravan Meeran [(1)], Johannes Ingrisch [(1)], David Reinthaler [(1)], Lena Müller [(1)], Alberto Canarini [(2)], Andreas Richter [(2)], Wolfgang Wanek [(2)], Erich M. Pötsch [(3)], Michael Bahn [(1)]

(1) Institute of Ecology, University of Innsbruck, Austria, (2) Department of Microbiology and Ecosystem Science, University of Vienna,Austria, (3) Institute of Plant Production and Cultural Landscape, Agricultural Research and Education Centre, Raumberg-Gumpenstein,Austria

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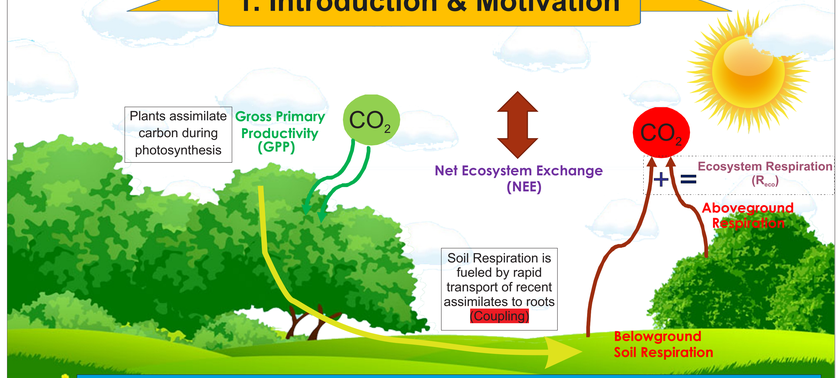
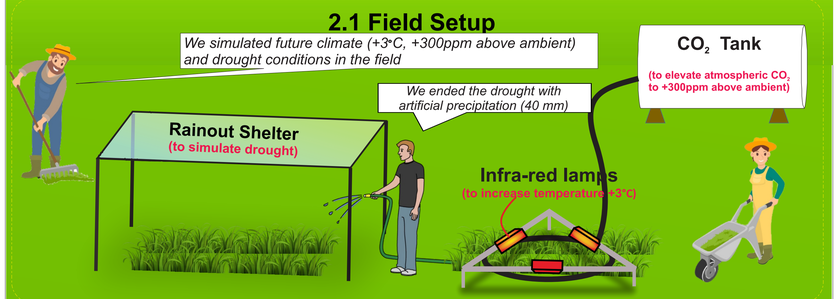
1. Introduction & Motivation



- Ecosystem CO_2 fluxes such as GPP and soil respiration play an important role in balancing the CO_2 concentration in the atmosphere
- We wonder how GPP, soil respiration, and their coupling will change under future climate where droughts are expected to become more frequent [Research question]
- We think that future climate will increase GPP, soil respiration and their coupling and that drought will reduce them. Moreover, the effect of drought and the recovery from drought will be amplified in a future climate [Hypothesis]

2. Methodology

2.1 Field Setup



2.2 Measurement Setup

2.2.1 Ecosystem CO_2 fluxes

We calculated ecosystem CO_2 [GPP, R_{eco}, NEE fluxes] by measuring CO_2 concentration changes inside this chamber

2.2.2 Soil respiration and recent carbon respiration [Pulse labeling]

We traced the fate of carbon from GPP to soil respiration by making the plant assimilate labeled $^{13}CO_2$ for photosynthesis

Then we measured soil respiration and recent carbon ($^{13}CO_2$) in soil respiration using a laser isotope spectrometer

3. Results

3.1 Ecosystem CO_2 Fluxes

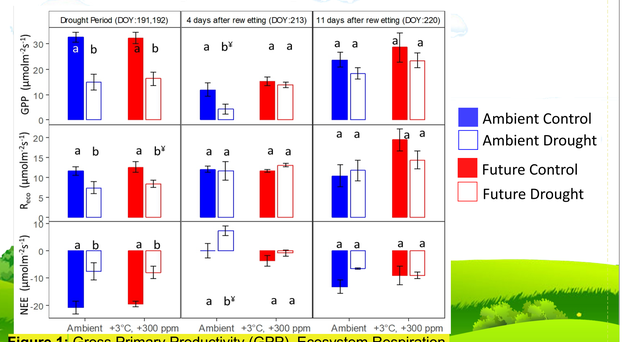


Figure 1: Gross Primary Productivity (GPP), Ecosystem Respiration (R_{eco}) and Net Ecosystem Exchange of CO_2 (NEE) during drought and 4 days after rewetting and 11 days after rewetting

3.2 Soil Respiration and Recent Carbon Respired

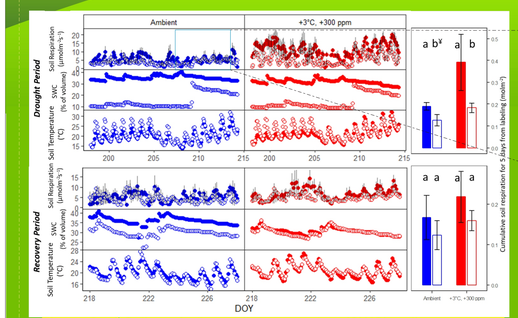


Figure 2: a) Soil respiration, soil water content (SWC), soil temperature during drought (top) and recovery period (bottom). **b)** cumulative soil respiration (right)

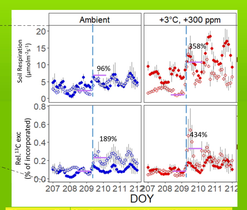


Figure 3: Soil respiration (top) and recent carbon respired (in % relative to initial uptake) during rewetting (bottom)

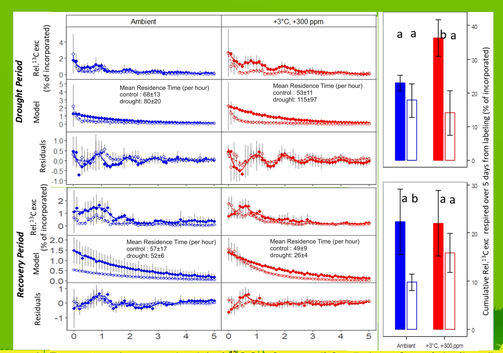
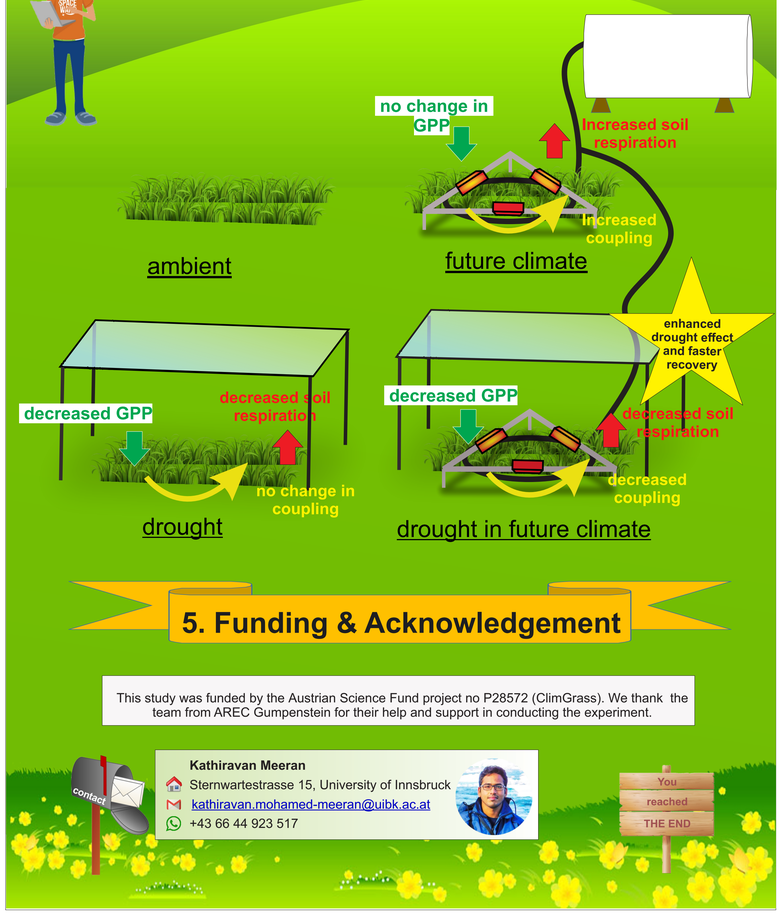


Figure 4: Recent carbon respired (rel $^{13}CO_2$) from soil for 5 days from labeling (in % relative to initial uptake). The values were fitted with an exponential decay model and mean residence time was calculated using the decay rate (left). Cumulative of recent carbon respired for 5 days from labeling (in % relative to initial uptake)(right)

4. Conclusion

- In a future climate, warming and elevated CO_2 have a stronger influence on belowground than on aboveground CO_2 fluxes, which resulted in an increased carbon allocation to soil respiration.
- Drought reduces carbon uptake and soil respiration. In a future climate the effect of drought was amplified through enhanced soil moisture reduction. Furthermore, the future climate induces a faster recovery of carbon uptake and allocation from drought.



5. Funding & Acknowledgement

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Kathiravan Meeran
Sternwartestrasse 15, University of Innsbruck
kathiravan.mohamed-meeran@uibk.ac.at
+43 66 44 923 517

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