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Effects of multiple climate change factors and their seasonal variation on the soil microbial community and its functions

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The rise in atmospheric CO_2 concentrations, and the associated increase in global warming and likelihood of severe droughts, is altering terrestrial carbon (C) and nutrient cycling, with potential feedback to climate change. Soil microbial communities and their functioning represent a major research area in this context. Microbes regulate important biogeochemical functions, including C fluxes between the biosphere and atmosphere and the availability of essential nutrients for plant growth, such as nitrogen (N) and phosphorous (P). Thus, improving our ability to quantify microbial responses to climate change is of utmost importance. While each climate change factor has been widely studied individually, it was shown that their combined effect is difficult to predict from the simple knowledge of each single factor.

In 2013, a climate change experiment ("ClimGrass") was set up on a montane grassland in Austria, with the aim to assess the potential interaction of multiple climate change factors (warming, elevated CO_2 and drought) on the functioning of managed grasslands. The experimental design followed a response surface model approach for warming and elevated CO_2, with each factor having two levels of increase above ambient (+1.5 and +3°C for warming and +150 and +300ppm for elevated CO_2). Drought was nested on this experimental design within a subset of treatments and implemented in multiple years. This design, combined with multiple harvests across seasons and years, allowed us to test the potential for interactive, non-linear and seasonal effects of multiple climate change factors.

Across multiple years and seasons, we analyzed parameters related to soil microbial communities and their functions in relation to the biogeochemical cycles of C, N and P. By using a large range of approaches, from *in situ* stable isotope labelling to the analyses of functional genes, we covered different aspects related to the cycling and stability of C in soil and to major processes involved in nutrient cycling.

In this talk, I will provide an overview of the multiple experiments carried out in ClimGrass. I will show that combined elevated CO_2 and warming can have minor but important interactive and non-linear responses that cannot be predicted by studying each factor individually. Seasonality represents a major mediator of climate change effects on important microbial functions, an aspect that is often overlooked. I will also focus on the response of soil microbial communities to drought

and the implications of combined warming and elevated CO_2 treatments.

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