Geophysical Research Abstracts
Vol. 19, EGU2017-13322, 2017
EGU General Assembly 2017

Does drought legacy alter the recovery of grassland carbon dynamics from drought?

Michael Bahn (1), Roland Hasibeder (1), Lucia Fuchslueger (2), Johannes Ingrisch (1), Thomas Ladreiter-Knauss (1), Georg Lair (1), David Reinthaler (1), Andreas Richter (2), and Rüdiger Kaufmann (1)

(1) University of Innsbruck, Institute of Ecology, Innsbruck, Austria (michael.bahn@uibk.ac.at), (2) University of Vienna, Department of Microbiology and Ecosystem Science, Vienna, Austria

Climate projections suggest an increase in the frequency and the severity of extreme climatic events, such as droughts, with consequences for the carbon cycle and its feedbacks to the climate system. An important implication of increasing drought frequency is that possible legacies of previous droughts may increasingly affect ecosystem responses to new drought events, though this has been rarely tested. Based on a series of severe experimental droughts performed during nine subsequent years on a mountain grassland in the Austrian Alps, we present evidence of effects of drought legacies on the recovery of grassland carbon dynamics from drought and analyse the underlying mechanisms.

Both single and recurrent droughts led to increased aboveground productivity during drought recovery relative to control plots, favoring the biomass production and leaf area of grass species more strongly than of forbs. Belowground productivity was significantly increased during recovery. This led to higher total root length, even though specific root length was strongly reduced during recovery, particularly after recurrent drought events. Following rewetting, the temperature dependence of soil respiration was increasingly diminished and the Birch effect declined with progressive recurrence of droughts. This was paralleled by a change in soil aggregate stability and soil porosity in plots repeatedly exposed to drought.

Isotopic pulse-labelling experiments revealed effects of drought legacy on plant carbon uptake and belowground allocation and altered microbial turnover of recent plant-derived carbon during and after a subsequent drought. Shifts in tissue nitrogen concentration indicate that drought effects on soil nitrogen turnover and availability could play an important role in the recovery of grassland carbon dynamics following both single and recurrent droughts.

In conclusion, drought legacies can alter the recovery of grassland carbon dynamics from drought, the effects increasing with increasing drought frequency and involving changes in both plant functional composition and soil structure and processes.