Effects of plant productivity and species richness on the drought response of soil respiration in temperate grasslands

JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

ID 4492921
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Year 2018
Title Effects of plant productivity and species richness on the drought response of soil respiration in temperate grasslands
Journal PloS one
Volume 13
Number 12
Pages / **Article-Number** e0209031
Mesh terms Biomass; Carbon Cycle; Droughts; Grassland; Poaceae, metabolism; Seasons; Soil, chemistry; Temperature
Soil respiration plays a crucial role in global carbon cycling. While the response of soil respiration to abiotic drivers like soil temperature and moisture is fairly well understood, less is known about the effects of biotic drivers, such as plant above- and belowground productivity or plant diversity, and their interactions with abiotic drivers on soil respiration. Thus, current predictions of soil respiration to summer droughts might miss relevant biological drivers and their interactions with abiotic drivers. Since drought events are expected to increase in Central Europe in the future, we simulated early summer drought using rainout shelters at 19 grassland sites, which differed in plant productivity and species richness in central Germany in 2002 and 2003. We tested the potentially interacting effects of drought with biotic drivers, i.e. annual above-ground productivity, species richness and root biomass, on the drought response of soil respiration in temperate grasslands. In both years, drought led to a significant reduction in soil respiration. The drought-induced reduction in soil respiration was largely driven by the reduction in above-ground productivity in response to drought. The extent of the drought response of soil respiration was dependent on the species richness level of the site and this interacting effect was explainable by the variation in root biomass (root biomass and species richness were positively correlated). Our findings highlight the importance of biotic drivers for the quantification of the drought response of soil respiration in grasslands.
Publisher PUBLIC LIBRARY SCIENCE
ISSN/ISBN 1932-6203
edoc-URL https://edoc.unibas.ch/67895/
Full Text on edoc No;
Digital Object Identifier DOI 10.1371/journal.pone.0209031
PubMed ID http://www.ncbi.nlm.nih.gov/pubmed/30576332
ISI-Number 30576332
Document type (ISI) Journal Article