Geophysical Research Abstracts
Vol. 20, EGU2018-17091, 2018
EGU General Assembly 2018

Responses of rhizospheric, mycorrhizal and heterotrophic respiration to drought and to plant CO_2 uptake in dry grasslands

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The main objective of the present study was to describe the responses of autotrophic and heterotrophic components of soil CO_2 efflux to the changes of soil water content (SWC) and plant CO_2 uptake (gross primary production, GPP) in a sandy grassland in Hungary.
Mesh-collar technique was applied to separate the different components of the total respiration. Data were collected (1) in root-exclusion plots, (2) in root- and mycorrhiza exclusion plots and (3) in control plots (roots and mycorrhiza included). Soil CO_2 efflux was measured continuously by using an automated open system of 10 soil respiration chambers.
The average contribution by rhizospheric respiration was 36±21%, the contribution by mycorrhizal respiration to the total soil respiration was 9±9% while the contribution by heterotrophic respiration was 55±21% on average during the three-year study period. Rhizospheric and mycorrhizal respiration depended on GPP and SWC during the most active period of the year. Mycorrhizal respiration responded to GPP with a time lag of 0-2 days in active period showing fast translocation of photosynthetic products to root-associated organisms. Drought affected the autotrophic component of soil respiration the most intensively: an increase from the minimum to the optimal soil water content resulted in increase of total soil respiration by 175% while the respiration of root-excluded (mycorrhizal+heterotrophic respiration) and root- and mycorrhiza excluded (heterotrophic respiration) plots increased by 127% and 93%, respectively. According to our results, the heterotrophic component of soil respiration is the major contributor to the respiration activities during drought events.