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CO_2 efflux in a mountain grassland under manipulated precipitation distribution

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Probably the best studied aspect of climate change is the predicted increase of global mean surface temperature and its effect on ecosystem processes. However, there are other important aspects of the climate change like e.g. changes in the frequency and amplitude of extreme meteorological events, namely drought, heavy precipitation events, and soil frost. Changes in precipitation may vary substantially on relatively small horizontal scales, particularly in areas of complex topography. In central Europe, precipitation is likely to increase in winter but decrease in summer and the risk of summer drought is likely to increase.

Here we focused only on ecosystem CO_2 efflux response to drought. Measurements of CO_2 efflux were carried out in the mountain grassland ecosystem located at the Beskydy Mts., the Czech Republic, using a portable infrared gas analyzer operating as a closed system. Six roofs (1.5 x 3.0 m) were installed on the grassland in May 2011 and 2012. They consisted of a wooden construction and acrylate plates. Two arrangements of the plates resulted in capturing precipitations and induction of drought (dry variant) or full release of precipitations (wet variant) through the roof. Four collars under each roof were installed before the first measurement in 2011 and they remained at their positions through two years. CO_2 efflux and soil temperature were measured mostly twice per month. Under each roof, two soil moisture sensors were installed. The grass in the collars was clipped once per year when the grassland was mowed. Wetting of the dry variant was performed. It simulated about 30 mm rainfall missing during the first half of the growing season.

Results showed that already during the first measurement of CO_2 efflux after two weeks of roof installation in 2011 a significant difference between dry and wet variant was determined (dry variant 19% lower than wet). During the following four measurements the difference between variants increased even about twofold. Clipping of the above-ground biomass had a significant effect on CO_2 efflux in both variants. CO_2 efflux decreased after clipping by 28.7 and 11.8 % in the wet and dry variant, respectively. After wetting of the dry variant in late summer in 2011 no significant difference in CO_2 efflux between variants ($p>0.05$) was determined. In 2012, there was a significant difference in CO_2 efflux between wet and dry variant already before roof installation. The difference between two variants increased till summer and then it remained similar (about 43 %). After clipping during this year, CO_2 efflux in both variant decreased about 28.2 %. Wetting was provided several days after roof removal. After we observed significantly higher CO_2 efflux in the dry variant than in the wet variant.
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