Submitted Abstract

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First Author First Name Last Name	 Lisa (1) Capponi
Submitting Author First Name Last Name	 Lisa Capponi
Correspondence	lisa.capponi@uibk.ac.at
Co-Authors **>> E-Mails will be not listed**	Neuner, Gilbert (1); Still, Christopher (2); Schaumberger, Andreas (3); Bahn, Michael (1)
Organisations	1: University of Innsbruck, Austria 2: Oregon State University, Corvallis, Oregon, USA 3: HBLFA Raumberg-Gumpenstein, Irdning, Austria
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Abstract

Multiple drivers of global change, including elevated CO2 concentrations, warming and drought, are increasingly affecting ecosystems worldwide. While their individual effects on plants and ecosystems have been comparatively well studied, their interactive effects are still poorly understood. Leaf temperatures are crucial for a range of plant processes and connect plant water relations to the energy balance and can thus be triggers and indicators of heat and water stress under extreme climate conditions. However, to date little is known on how they are affected by interacting global change drivers. In this study, based on a multi-factor global change experiment in managed mountain grassland, we investigated the individual and combined effects of summer drought, future warming (+3 °C) and future CO2 concentrations (+ 300 ppm) on leaf temperatures, stomatal conductance, and chlorophyll fluorescence, which was studied as an indicator of stress. Canopy and leaf surface temperatures were measured using Infrared imaging (IR); stomatal conductance and chlorophyll fluorescence were assessed at the leaf scale using a porometer combined with a fluorometer. Preliminary results show that, during sunny days, mid-summer warming and elevated CO2 increased leaf temperatures compared to ambient conditions. Drought caused significantly higher leaf temperatures compared to warming and elevated CO2. When drought was combined with future warming and CO2 concentrations, i.e., when all three global change drivers interacted, leaf temperatures were most strongly increased. Leaf temperatures were inversely related to stomatal conductance. No significant treatment-related effect was observed when measuring chlorophyll fluorescence. Interestingly, drought effects on leaf temperatures persisted also during the period of plant recovery from drought. Overall, we conclude that in a future warmer climate under elevated CO2, drought effects on leaf and canopy surface temperatures are much more pronounced compared to drought under ambient current conditions, potentially inducing or exacerbating plant stress and reducing grassland resistance to such extreme climatic events.