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Separating drought effects from roof artefacts on ecosystem processes in a grassland drought experiment

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Given the predictions of increasing risk of long drought periods under various climate change scenarios, there have been numerous experimental field studies simulating drought using transparent roofs in different ecosystems and regions. Such roofs may, however, have unknown side effects, here called artefacts, on the response variables potentially confounding experimental results and misleading conclusions. Knowing the ecosystem response to such roof artefacts is therefore indispensible to correctly predict the effects of drought on the composition and functioning of ecosystems. We therefore aimed at filling this gap by studying the relevance of roof artefacts in a temperate grassland ecosystem. We compared pure drought effects to roof artefacts by measuring the response of three ecosystem properties (aboveground biomass, litter decomposition and plant metabolite profiles).
We realized three treatments: a drought treatment simulated by means of transparent roofs, an unroofed control treatment receiving natural rainfall and a roofed control, with rain water applied according to ambient conditions. The roof constructions in our experiment caused a slight change in air (+0.14 °C during night) and soil (−0.45°C on warm days, +0.25 °C on cold nights) temperatures while photosynthetically active radiation was decreased (-16%) on bright days. Aboveground plant community biomass was reduced in the drought treatment (−41%), but there was no significant difference between the roofed and unroofed control, thus there was no measurable response of aboveground biomass to roof artefacts, but a considerable response to drought. Compared to the unroofed control, litter decomposition was decreased both in the drought treatment (−26%) and in the roofed control treatment (-18%), suggesting a response of litter decomposition to roof artefacts in addition to drought. Similarly, aboveground metabolite profiles in the model plant species Medicago x varia were significantly different from the unroofed control both in the drought and in the roofed control treatments. Our results stress the need for roofed control treatments when using transparent roofs for studying drought effects because of significant roof artefacts.