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# The effect of rain-out shelters on the microclimate of vegetation patches

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It is commonly expected that climate change will increase the probability of extreme weather events. The potential impact of such events on ecosystems can be explored with manipulation experiments at the field scale using rain-out shelters to simulate altered precipitation regimes and extreme droughts. Despite their economical use and ease of deployment it is known, however, that rain-out shelters not only exclude precipitation, but change the microclimate of the enclosed vegetation by modifying the radiation and wind regimes.

We investigated the microclimatological impacts of rain-out shelter using a horizontal mobile measuring system (HMMS) as part of the EVENT II experiments at the University of Bayreuth in 2012. The EVENT II experiment explores the effects of extreme weather events (drought at different times in the year) as well as summer and winter warming in interaction with land-use intensity on the ecosystem performance of a semi-natural grassland community. The HMMS collected observations outside and inside the rain-out shelters moving along a set of tracks installed in a U-shape with a total sampling time of 10 min per lapse. The measurements were used to quantify the differences in radiation components, air temperature, and air moisture between within and outside the shelters. We explain the observed differences in terms of differences in external forcing variables related to common weather modes. The impact on evapotranspiration is explored by using the observations as input variables for the Penman-Monteith model to estimate actual evapotranspiration.

The found differences were most pronounced for down-welling long- and short-wave radiation. Plant surface temperature, inferred from outgoing long-wave radiation, consistently increased inside the shelters and additional measurements with non-moving thermometers show that near-ground minimum temperatures inside the shelter can be up to 3-4 K higher than outside during clear-sky nights. Contrary to initial expectations, the HMMS measurements indicated lower air temperature under the roof for these nights. The effect can be explained by differences in the shape of the height-dependent temperature profiles and highlights the importance of measurement height on air temperature observation in rain-out shelters.