Information relevant to experiment 1

Related files and script:

experiment\_1\_cummulative\_flux\_analysis.R

experiment\_1\_flux\_curve.xls

experiment\_1\_flux\_curve\_analysis.R

GPP responses to a gradient of precipitation sizes

For our first experiment (experiment\_1), we investigated the GPP response of moss (“moss”) and cyanobacteria (“cyano”) crusts to different watering amounts (Treat). We applied a single watering treatment to3 samples of moss and cyanobacteria crusts using a spray bottle with the following volumes of deionized water: 1.8 mm, 2.7 mm, 5.4 mm, 7.7 mm and 10 mm (total of 30 mesocosms; *n* = 15 for moss crust and *n* = 15 for cyanobacteria crust). We measured GPP by calculating the difference between respiration (*R*) and net soil exchange (NSE; Darrouzet-Nardi 2015). NSE is the difference between gross fluxes of CO2 uptake from photosynthetic biocrust organisms and CO2 released. NSE is distinct from net ecosystem exchange (NEE) in that it doesn’t include vascular plant fluxes. Despite not having vascular plants in our greenhouse experiment, we retained the use of NSE as a way to keep consistency across measurements of biocrust CO2 exchange. NSE was measured using a custom-made transparent chamber that allowed ambient light to reach the biocrust organisms (Figure S1) that sealed over the mesocosm and attached to a LI-8100A Automated Soil Gas Flux System (Li-Cor Inc, Lincoln, NE, USA). NSE measurements began 15 minutes after the initial watering.After NSE measurements, we placed an opaque box over the biocrust sample for 15 minutes, then removed the box to measure *R* in the dark using an opaque 10 cm Survey Chamber. This repeated every 30 minutes for 210 minutes, an amount of time shown to capture the full profile of CO2 fluxes from biocrusts at the smallest water level (Reed et al. 2012). CO2 fluxes were calculated using Li-Cor File Viewer software by the linear fit to the water-corrected CO2 concentration change over a 2.5-minute period following a 30-s dead band.

Statistical analyses

Statistics were performed using R version 2023.03.1+446 (R Core Team 2022). For our first experiment, we used a generalized additive model (GAM) to compare GPP over time and across watering amounts within crust types. GAMs are nonparametric generalized regression models that fit smoothing curves using cubic regression splines for nonlinear data that allow for random effects (Zuur & leno 2016). GAMs were constructed with additive smoothing functions for time and biocrust type by treatment so that ten different smoothing curves were fit to the five different treatments for each biocrust type (cyanobacteria and moss). GAMs were fit using the mgcv package in R (54) using the restricted maximum likelihood method to stabilize smoothing parameters and a Gaussian family distribution. Post-hoc model analyses for parametric estimated marginal means were conducted using linear mixed effect models, following with Sidak comparisons using the emmeans package (Lenth 2023).