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Biological soil crusts regulate evaporation dynamics and energy partitioning over terrestrial surfaces

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Biological soil crusts (hereafter, biocrusts) occurring in drylands modify near-surface soil properties which influences land-atmosphere interactions and exchanges of energy and matter. Yet, the impact of biocrusts on soil evaporation lacks a mechanistic understanding of the biological processes that modify the crusts' physical properties. We used controlled laboratory experiments, field observations, and mechanistic modelling to determine the impact of biocrusts on evaporation dynamics and subsurface thermal regimes. Our experiments were conducted with bare soil and different types of biocrusts along the ecological succession of the Succulent Karoo desert, South Africa. The preliminary results highlight how different thermal and radiative properties of the crusts affect evaporation rates and heat transfer into the soil layers beneath. Furthermore, active water uptake and storage by biocrust organisms result in water redistribution, which shapes energy balance during diurnal cycles. We conclude from the mechanistic model that biocrusts can accelerate the vertical transport of substrates at the cost of evaporative water loss. Thus, biocrusts may have evolved to modify soil physical properties for balancing nutrient turnover and water usage in global drylands highlighting their crucial roles in regulating mass and energy exchanges over terrestrial surfaces.