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Soil crusts to warm the planet

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Soil surface temperature, an important driver of terrestrial biogeochemical processes,
depends strongly on soil albedo, which can be significantly modified by factors such as plant cover. In sparsely vegetated lands, the soil surface can also be colonized by photosynthetic microbes that build biocrust communities. We used concurrent physical, biochemical and microbiological analyses to show that mature biocrusts can increase surface soil temperature by as much as 10 °C through the accumulation of large quantities of a secondary metabolite, the microbial sunscreen scytonemin, produced by a group of late-successional cyanobacteria. Scytonemin accumulation decreases soil albedo significantly. Such localized warming had apparent and immediate consequences for the crust soil microbiome, inducing the replacement of thermosensitive bacterial species with more thermotolerant forms. These results reveal that not only vegetation but also microorganisms are a factor in modifying terrestrial albedo, potentially impacting biosphere feedbacks on past and future climate, and call for a direct assessment of such effects at larger scales. Based on estimates of the global biomass of cyanobacteria in soil biocrusts, one can easily calculate that there must currently exist about 15 million metric tons of scytonemin at work, warming soil surfaces worldwide