Biocrusts effects on water soil erosion in arid ecosystems: a matter of scale

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Biocrusts are intimate associations between soil particles and lichens, mosses, fungi, cyanobacteria, algae, and other bacteria that live within or on the very top of the soil surface. It is broadly accepted that biocrusts constitute powerful protective agents against water erosion in drylands. However, this effect has been demonstrated only at the plot scale, and it may change at coarser scales. Biocrusts are, very often, runoff sources, and the additional runoff generated on them may cause downslope erosion or on the contrary may represent an additional supply of water for downslope vegetation allowing its survival. In this work, we make use of three years field data, from two ecosystems, at different spatial scales and modeling procedures to analyze the effects of biocrusts on water erosion. Our results support the well-known effect of biocrusts stabilizing soil surface and reducing erosion. This effect increases with biocrust development, especially during intense erosive events, but after a rainfall intensity threshold, of about 50mmh^{-1}, is reached, biocrust is altered and erosion and OC losses are triggered. The importance of biocrusts protective effect is less visible when the study scale was enlarged from plot to catchment because of water and sediment redistribution from source to sink areas within the catchment. Thus, while biocrust removal may increase more than 20 times sediments and OC losses in the upper sectors of a hillslope, at the catchment outlet loss rates are only tripled. At these scales, biocrusts spatial distribution and infiltration capacity of vegetated areas are crucial factors on catchment erosion, and are modulated by rainfall properties. Their effects may be especially important during high magnitude events, when the buffer capacity of vegetation is exceeded and the biocrusts-runoff becomes connected with the catchment outlet.