Spatially uniform surface runoff as a result of erosion-induced high hydrolocal connectivity over an extremely degraded catchment

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Previous studies have suggested that runoff reduces with slope length, and the scaling trend diminishes with the degree of land degradation. This study further hypothesized that runoff is scale-independent and spatially uniform in extremely degraded landscapes. We tested the hypothesis on the Chinese Loess Plateau. Runoff data were collected from a densely rilled and gullied loess headwater with soil erosion intensity close to 20,000 t km⁻² yr⁻¹. The data included observations from seven arable experimental plots of various lengths (20 to 164 m) and gradients (9 to 32°), as well as the headwater outlet. The results showed that the erosion-induced network of rills and gullies lowered runoff reinfiltration and resulted in exceptional high flow connectivity, thus obscuring the effects of other environmental conditions (mainly topography) and contributing to uniform runoff from the upper hillslope to the headwater outlet. The observations held at the event, annual, and mean annual time scales, implying that the investigated watershed is simply the sum of individual slopes. This study highlights the effect of erosion processes on the ensuing runoff yield. The effect should be fully addressed in studies of runoff yield in semi-arid areas, which are among the most erodible landscapes due to sparse land cover.