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Rill network development and soil erosion: a laboratory study of rainfall intensity and slope angle

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Energy expenditure and rill network development were studied with novel treatments, among other research aspects, in relation to a climate change scenario assuming heavy precipitations. We therefore analyzed the effect of rainfall intensity, rainfall duration and slope angle on the soil erosion and the development of rills. Total rainfall amount was held constant in all treatments. The laboratory equipment consisted of a rainfall simulator and a box with a water distribution system for the soil material. Photogrammetric analysis was used to survey the changes of the soil surface and to analyze the development of rill networks.

The results showed a positive, non-linear relation between soil erosion, rill development, applied rainfall intensity and slope angle. The higher the rainfall intensity and the larger the slope angle, the larger was the total sediment yield and the faster and stronger decreased the rill density and energy expenditure. Variations in the rainfall intensity had stronger effects for the given treatments. The erosion processes were dominated at the beginning by sheet erosion. Subsequently, the formation and connection of shallow depressions resulted in a first network. Surface discharge dominated afterwards and this first network was formed out by back-cutting and side erosion. Large and deeply incised rill networks developed at high rainfall intensities and large slope angles. Therefore, we were able to demonstrate that high erosion rates were linked to high rainfall intensities, large slope angles and the formation of rill networks. The experimental results can help to characterize the response of rill networks on changes

in precipitation pattern of the future as is predicted in the latest IPCC-report.