Geophysical Research Abstracts
Vol. 18, EGU2016-5744, 2016
EGU General Assembly 2016

Evolution of overland flow connectivity in bare agricultural plots

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Soil surface roughness not only delays overland flow generation but also strongly affects overland flow distribution and concentration. Previous studies generally aimed at predicting the delay in overland flow generation by means of a single parameter characterizing soil roughness. However, little work has been done to find a link between soil roughness and overland flow dynamics. This is made difficult because soil roughness and hence overland flow characteristics evolve differently depending on whether diffuse or concentrated erosion dominates. The present study examines whether the concept of connectivity can be used to link roughness characteristics to overland flow dynamics. For this purpose, soil roughness of three 30-m^2 tilled plots exposed to natural rainfall was monitored during 2 years. Soil micro-topography was characterized by means of photogrammetry on a monthly basis. Soil roughness was characterized by the variogram, and overland flow connectivity by a functional connectivity indicator called the Relative Surface Connection function (RSCf). Overland flow hydrograms were generated by a physically-based overland flow model (FullSWOF_2D) on 1-cm resolution digital elevation models. The development of eroded flow paths at the soil surface not only reduced the delay in overland flow generation but also resulted in a higher continuity of high flow velocity paths, an increase in erosive energy and a higher rate of increase of the overland flow hydrograph. Overland flow dynamics were found to be highly correlated to the RSCf characteristic points. This high correlation shows the potential of the RSCf both to serve as a quantitative link between soil roughness and overland flow generation by providing information regarding overland flow dynamics and to improve the overland flow hydrograph prediction.