Geophysical Research Abstracts
Vol. 12, EGU2010-10012, 2010
EGU General Assembly 2010

Observations of flow path interactions with surface structures during initial soil development stage using irrigation experiments

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Structures and processes are dynamically linked especially during initial stages of soil and ecosystem development. Here we assume that soil pore structures and micro topography determine the flow paths and water fluxes as well as further structure changes. Reports about flow path developments at the soil surface are still limited because of an insufficient knowledge of the changing micro topography at the surface.
The objective of this presentation is to evaluate methods for parameterisation of surface micro topography for analysing interactions between infiltration and surface runoff.
Complex irrigation experiments were carried out at an experimental site in the neighbourhood of the artificially created water catchment “Chicken Creek”. The irrigation rates between 160 mm/h and 250 mm/h were held constant over a time period of 20 minutes. The incoming intensities were measured as well as the raindrop-velocity and -size distributions. The surface runoff was continuously registered, soil samples were taken, and soil water potential heads were monitored using tensiometers. Surface and subsurface flow paths were identified using different tracers. The soil surface structures were recorded using a high resolution digital camera before, during, and after irrigation. Micro topography was surveyed using close-range photogrammetry.
With this experimental design both, flow paths on the surface and in the soil as well as structure and texture changes could be observed simultaneously. In 2D vertical cross-sections, the effect of initial sediment deposition structure on infiltration and runoff was observed. Image analysis of surface pictures allowed identifying structural and soil textural changes during the runoff process. Similar structural changes related to surface flow paths were found with the photogrammetric surface analysis.
We found evidence for the importance of the initial structures on the flow paths as well as a significant influence of the system development. Flow paths tended to orient along initial structures and changes during the early stages of development. The amount of runoff increased from about 20% of irrigation on the first stage to 50% for the same plot one year later.
The data will be used in 2D and 3D numerical simulations of the observed surface and soil water fluxes.