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Interactions between surface structures, runoff and erosion in an artificial watershed during the initial ecosystem development

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In its initial phase an ecosystem can be characterized as a Geo-(Hydro-)System since biotic compartments are still missing to a large extent. In this very first stage of the ecosystem development the hydrological processes forming the first surface structures are mainly controlled by runoff patterns and by the physical properties of the surface and the substrate. Based on that, it can be hypothesized that the initially formed structures are responsible for the future development of the ecosystem and define later structures.

However, initial structures are very dynamic, and few alterations of surface properties may initiate the development of completely new patches and patterns which again control surface processes like erosion and sedimentation. Loose sand and other fine particles are transported directly by wind and water from the upper initial soil surface and a first physical soil crust is formed very quickly. This new surface exhibits clearly different properties compared with the original initial surface. For example, infiltration can be minimized and surface runoff is promoted by this crusting. In contrast, sandy or silty substrate that has been relocated by erosion processes into small hollows of the surface changes the soil physical properties of these parts of the landscape as well but into another direction. In these parts of the system the sedimentation may create small patches with higher infiltration rates and eventually better water storage capacities. This may result into the formation of initial vegetation patches and patterns which in turn influence the further quality and quantity as well as the location of soil surface processes.

Against this background this paper presents a recently launched research project using an artificially created water catchment of 6 ha in size. This site called ‘Chicken Creek’ (‘Hühnerwasser’) was established in 2005 in Lusatia (Germany) and is the central research site of a German-Swiss Collaborative Research Centre dealing with structures and processes of the initial ecosystem development phase. The catchment was designed as a landscape laboratory representing an initial ecosystem starting its development at ‘point zero’. This point zero is very well documented as a comprehensive monitoring programme was started immediately after the completion of the site in autumn 2005. The catchment was built up of sandy substrate which was dumped by large mining devices and flattened by caterpillars afterwards. No further measures of reclamation have been carried out so that the site undergoes an unrestricted ecosystem development. Also erosion processes underlie no restrictions.

In the first three years of this development already several surface structures and their interactions could be detected. As it was expected, the initially not vegetated area showed massive substrate dislocation by erosion and the formation of numerous gullies. However, the invasion of plants also started very soon after the ‘point zero’ so that a complex mosaic of large active gullies, shallow fixed gullies with vegetation cover as well as alternating crusted and vegetated surfaces patches between these erosion structures is emerging. Monitoring of erosion processes as well as the analysis of the interactions and the complex feedback of these different structures will be an important issue for the Collaborative Research Centre. This paper presents first results of the monitoring programme and concepts of future measurements.