Geophysical Research Abstracts
Vol. 12, EGU2010-7350-1, 2010
EGU General Assembly 2010

Design and application of a drip-type rainfall simulator adapted to steep topography and low intensity-rainfall characteristics in the Coastal Range of Southern Chile

Christian Mohr (1) and Huber Anton (2)

(1) Institute of Earth and Environmental Sciences, University of Potsdam, Potsdam, Germany (cmohr@uni-potsdam.de), (2) Institute of Geosciences, Faculty of Sciences, Universidad Austral de Chile, Valdivia, Chile (ahuber@uach.cl)

Besides being adaptable for measuring infiltration, overland flow and sediment transport simultaneously, rainfall simulator systems allow the observation of the processes of runoff generation and soil erosion, too. This enables the assimilation of additional qualitative data and makes a rainfall simulator system a very valid method in the investigation of soil-hydrological response to precipitation events. In the present study a cheap, handy, transportable and easy to set up rainfall simulator applicable for the steep terrain conditions of the Southern Chilean Coastal range was designed based on Bowyer-Bower & Burt (1989). The used drip-type rainfall simulator had to fulfill two main requirements: adaptive to steep topography and little in water consumption. The used simulator is set up by a dismountable rectangular metal rack of 0.5x1.0m basal surface and 2.5m height. The metallic structure enables the attachment of plastic boards for wind protection. Fixable telescopic extensions allow a firm adjustment to slopes up to 45°. Horizontal metallic frames at different heights increase the stability of the structure and carry the devices of the rainfall simulator. On the uppermost frame, two containers provided with calibrated scales spend the water to a fast reacting receptacle assuring constant water supply and pressure by the Mariotte's principle. The rainfall intensity is adjusted by a control-panel according to the Bernoulli principle. This guarantees a constant water flow which was verified by the water-volume leaving the calibrated containers on top. Interchangeable glass-tubes of different diameters in the control-panel permit the generation of various precipitation intensities (4-60 mm/h; SD =0.16mm). The frame beneath carries an acrylic glass box with approx. 600 drop-formers (fishing line inside a 0.76mm Tygon-tube) at its bottom. 20 cm below, a framed 5mm-spacing-mesh serves as a raindrop randomizer. At the base of the simulator sheet metals avoid lateral leakage of overland flow leading the runoff to a cemented trough. The experiments were conducted until a steady state infiltration rate was observed or the runoff ceased. The runoff samples are taken manually in intervals of 5 or 10 min depending on the simulated intensity and amount of runoff. All bottled samples were filtered to determine the sediment concentration. To test the system's effectiveness a pilot-study was conducted in a granitic soil catchment. The obtained values of the infiltration rate indicate that soil physical properties in this area facilitate rapid infiltration and slope did not show main influence. The sediment concentration showed high variability due to heterogeneity of surface and soil characteristics. In a succeeding study 36 rainfall simulations prior to clear-cuts during dry summer-season and rainy winter-season were carried out to determine the effect of both silvicultural practices on micro-scale. Soil hydrological response showed preferential flow patterns and variable infiltration-rates due to topsoil disturbance in the course of previous timber-harvests and differences in soil depth, hydrophobic organic layers and imbedded rocks. Maximum steady state infiltration rates ranged between 7.3 and 32.3 mm/h. In contrast to the expected results, maximum infiltration occurred at steep slopes. Only little sediment transport was measured. Only under high precipitation on steep slopes a moderate sediment transport (0.074 g/l) was documented. Post clear-cut infiltration experiments will be conducted in Jan.-March 2010. Furthermore, a modified tipping-bucket-device will be installed as a runoff collector-device to gain better temporal resolution.