Geophysical Research Abstracts
Vol. 12, EGU2010-2769, 2010
EGU General Assembly 2010

Design and calibration of the small portable rainfall simulator of Trier University

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The need to distinguish the different partial processes of runoff generation and erosion led to the development of rainfall simulations on small plots. Since 1938 more than 100 rainfall simulators with plot dimensions less than 5 m^2 were developed. The advantages of small portable rainfall simulators are, among others, the easy transport in difficult areas and the low water consumption.
The small portable rainfall simulator of Trier University, which has been used since 1995 in Germany, Spain, Morocco and Burkina Faso, is a nozzle type rainfall simulator. In 2008/09 it was methodically improved focusing on rainfall characteristics like homogeneous spatial rainfall distributions and drop spectra.
The circular test plot is 60 cm in diameter with an area of 0.28 m^2. It is delimited by a steel ring of 7 cm height, which is introduced into the soil at least 3 cm. The V-shaped outlet is placed at the deepest point of the plot at surface level. Because of better spraying characteristics, the previously used hollow cone nozzle (Hardi Syntal 1553-89 10) has been exchanged by a full cone nozzle (Lechler 460.608), which is fed with a pressure of about 40 kPa (0.4 bar) at a height of 2 m. The water flow is now regulated by a flow metre (Type KSK-1200HIG100) positioned on a separate pole in 1.5 m height. The resulting rainfall intensity is maintained throughout experiments at around 40 mm h-1. During field campaigns four similar simulators are used.
Drop size distribution and drop fall velocities were analysed by means of a Laser Disdrometer (by Thies). Small rainfall collectors were used to measure spatial rainfall distribution.
Regarding drop size distribution, a very close relation to natural rainfall (Marshall & Palmer Distribution) can be observed. Due to low fall heights, measured drop fall velocities are slow, maximum velocities ranging between 3.4 to 5 m s-1. The spatial rainfall distribution of the small rainfall simulator is very homogenous with a Cu value of 91 %. The measured variables show extremely low fluctuations throughout all tests and are therefore reproducible in field investigations at any time.