Geophysical Research Abstracts,
Vol. 11, EGU2009-2169, 2009
EGU General Assembly 2009

Measuring splash erosion potential under vegetation using sand-filled splash cups

C. Geißler, T. Scholten, and P. Kühn

Eberhard Karls University Tuebingen, Geographical Institute, Department of Geomorphology and Soil Science, Tübingen, Germany (christian.geissler@geographie.uni-tuebingen.de)

In soil erosion research it is widely accepted that vegetation is not only protecting the soil from the erosive power of rainfall. Under specific circumstances (like they occur e.g. in forests) vegetation can enhance the erosive power of rainfall by modifying its properties (esp. drop size distribution, kinetic energy). The adjacent processes are very complex and variable in time and space and depend on numerous variables (e.g. rainfall intensity, drop size distribution, drop fall velocity, height of the canopy, density of the canopy, crown and leaf traits, LAI). In the last decades a large number of studies focused this process-system using different methods and came to often different results (Brandt 1989; Calder 2001; Foot & Morgan 2005; Hall & Calder 1993; Mosley 1982; Nanko et al. 2006; Park & Cameron 2008; Vis 1986).

The main objective of our field experiments in subtropical China is to quantify the modification of precipitation by its pass through the canopy layer for six different tree species, three different successional stages and three different biodiversity classes. For this, new splash cups were developed based on the archetype of Ellison (1947). In contrast to previous studies with splash cups (Vis 1986) or other forms of splash cups (Kinnell 1974; Morgan 1981) we measured the unit sand remaining inside the cup after single natural rainfall events. The new splash cups contain of a PE-flask to which a carrier system has been attached. In this carrier system a cup filled with unit sand of 125-200 μm particle size is inserted. At the bottom of the cup a silk cover is attached to avoid the loss of sand and to guarantee free drainage of water from the cup to the carrier and vice versa. Cup and PE-flask are hydraulically connected by a cotton wick to assure constant moisture content throughout the time of measuring. Additionally, vents in the carrier system ensure that the pressure arising from the insertion of the cup doesn't lead to a loss of sand. The vent in the PE-flask guarantees the free drainage of excess-water which could arise during high intensity rainfall events.

The splash cups were exposed to different tree species and in the open field. A total number of 520 partly simultaneous (max. 135 at once) measurements covering five different rainfall events have been carried out during the initial phase of the project. The first results show that sand loss under forest vegetation is up to 2.5 times higher than under open field conditions. Old forests (>80 years) produce a significantly higher amount of sand loss than younger forests (<25 years) which is mainly a function of stand height. The results also give implications for a relation of sand loss to different tree species. To calibrate the splash cup technique and calculate the kinetic energy of rain a laser disdrometer will be used during the next field campaign in 2009. This will allow us to use the splash cup measurements as input values for soil erosion models and to get a better understanding of the behaviour of forest ecosystems in erosion control.

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