Comparability of different rainfall simulators – Relevance and chances for soil erosion research

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Introduction

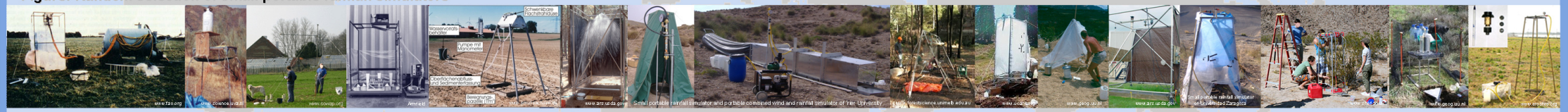
Rainfall simulation is an essential tool in research of recent process dynamics of soil erosion. Data are increasingly adopted for modeling and hence become an important base of information for decision-makers in application-oriented erosion protection. Worldwide many small rainfall simulators with different design, rainfall intensities, rain spectra etc. are used, and due to specialized research questions a standardization of rainfall simulation is not in sight. For this reason the Department of Physical Geography at Trier University would like to offer the possibility of comparing the simulators and ask the working groups to join a workshop with the aim of producing a list of criteria with correction factors. The proposed procedure is listed here.

Main objectives

- ➔ **Standardization of calibration methods for the artificially generated rainfall**
- ➔ **Generation of uniform pluviograms**
- ➔ **Parameter comparison of different small portable rainfall simulators**
- ➔ **Production of a list of criteria and agreement on the benchmarks for the comparison of the small portable rainfall simulators**
- ➔ **Inquiry of correction factors for the key dimensions runoff, infiltration and eroded material as input data for soil erosion modeling**
- ➔ **Sustainable advancement of the cooperation, especially at operational level**

Comparison of rainfall simulator parameters

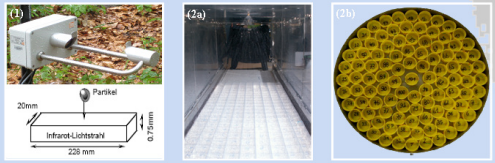
Figure: Random selection of small portable rainfall simulators



Standardization of rainfall calibration methods

Studies have proven that different calibration methods may lead to contradictory results (Ries er al. 2009). Worldwide very different calibration methods are applied for artificially generated rainfall. Hence, our working group considers the standardization of the calibration methods as the most urgent need for research.
Due to reliability of results and easy/good viability we prefer a Laser Disdrometer for drop spectrum and rain collectors for spatial distribution.

Preferred calibration methods



(1): Laser Disdrometer (Thies)
➔ drop diameter & fall velocity)

(2): Rain Gauges; a) square plot b) round plot
➔ spatial rainfall distribution

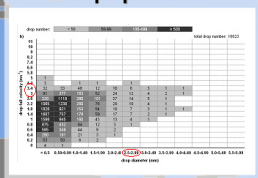
Ries, J.B., Seeger, M., Iserloh, T., Wistorf, S., Fister, W., 2009. Calibration of simulated rainfall characteristics for the study of soil erosion on agricultural land. Soil and Tillage Research 106, 109-116.

High-resolution & uniform data ➔ pluviograms

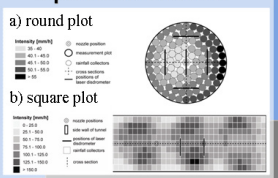
High-resolution and uniform data on rainfall characteristics can be generated as pluviograms.

- ➔ Direct comparison of the small rainfall simulators of Trier University and the respective small rainfall simulator of the co-operating working group
- ➔ Investigation of the drop spectra (drop size distribution, drop fall velocity) and the spatial distribution with uniform calibration methods
- ➔ Discussion with the working group leaders about basic approaches / obstacles in the direction of a measuring-technical standardization (rainfall intensity, precipitation characteristic)
- ➔ Production of a data catalogue

Drop spectrum



Spatial distribution



List of criteria

- ➔ Information exchange of all working groups concerning the features fall height of the artificial rainfall, nozzle system, intensity, plot size and test procedure with the aid of a questionnaire aiming on a topical and clear overview
- ➔ Discussion of this overview with all working groups
- ➔ Agreement and development of uniform benchmarks for the comparison of the small portable rainfall simulators
- ➔ Incuction of criteria for different estimation procedure of basic surrounding conditions like plot creation, measuring procedure and lab analysis

Correction factors for each rainfall simulator

- ➔ Comparative capture of runoff and eroded material of each small rainfall simulator...
  ...on standard soil under dry and moist conditions in three runs a 30 minutes
  ...on two fields (fallow and grassland) in three runs a 30 minutes
- ➔ Evaluation of correction factors which allows to compare the key factors runoff, infiltration and eroded material of the different small rainfall simulators
- ➔ Correction factors are determined by means of regression equations of different runoffs, soil losses and infiltration values of the compared rainfall simulators

Conclusion

The physical limitations of experimental soil erosion field equipment (e.g. fall height, artificial rainfall and plot creation) are obvious and well known. A general understanding about relevant features of the simulators as well as calibration and test procedure strategies would help to concentrate global results and knowledge so as to create a reliable and convincing source of information for decision-makers.

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