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A portable wind and rainfall simulator for in situ soil erosion measurements

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From laboratory investigations in wind tunnels that include rainfall simulators it is known that wind considerably modifies the velocity, angle and drop size of falling rain, leading to a complex interaction and alteration of the soil erosion process. Only few field investigations, mostly with passive sediment samplers, have been made that included both, wind and water erosion rates. The main reason for this lack of studies is the difficulty to compare the results of the different sampling methods. Consequently the key objective of this study is the development of a single device that is able to simulate erosion by wind and water operational in the field under comparable conditions. During the construction of the device the focus was set on the reproducibility of the simulations and the mobility of the tunnel. For this reason some limitations in the simulation of the natural processes had to be taken into account.

The working section of the portable wind and rainfall simulator is 4 m long, 0.7 m high, 0.7 m wide and rectangular in shape. A bounded plot of 2.2 m^2 can be irrigated by four pressure nozzles (Lechler type 460.608) with an intensity of about 90 mmh-1. The nozzles are positioned in the roof of the tunnel which causes a maximum fall height of 0.7 m. For sediment collection, a gutter system was combined with two wedge-shaped sediment traps and a beam with four Modified Wilson & Cook Samplers. The calibration results of the rainfall show, that the spatial drop distribution is not at all homogeneous, but very well reproducible. The simulated drop sizes/spectra correspond satisfactorily with calculated Marshal-Palmer Distributions of same rainfall intensities. Maximum drop velocities of 4-5 ms-1 are caused by the low fall height inside the tunnel. In combination with the simulation of wind, all above mentioned parameters definitely improve. Due to the short length of the tunnel, the pre-shaped boundary layer varies from 15-20 cm in height. Further velocity measurements indicate that the airflow within the lower 30 cm of the tunnel is sufficiently homogenous across the tunnel (deviation from mean 0.4-0.55 ms-1) and that the propeller induced rotating swirl is removed by the honeycomb.