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The influence of wind-driven rain on soil detachment rates on homogenous sandy substrate

Thomas Iserloh (1), Wolfgang Fister (2), Miriam Marzen (1), Manuel Seeger (3), and Johannes B. Ries (1)

(1) Trier University, Physical Geography, Trier, Germany (iserloh@uni-trier.de), (2) University of Basel, Physical Geography and Environmental Change, Basel, Switzerland, (3) Wageningen University, Land Degradation and Development, Wageningen, The Netherlands

Trier University's portable combined wind and rainfall simulator is a recently developed device for plot-scale in situ assessment of differences in erosion rates with and without the influence of wind on raindrops. Results from laboratory and initial field research showed an influence of wind on drop velocity, impact angle and kinetic energy and a subsequent increase of eroded material.
To facilitate extraction of influences most significant for our questions and to avoid systematic errors, a defined order of test runs was established. Consequentially, the aim of this study was to 1) verify the increase in erosion rates due to the application of wind to the rainfall simulation's setting, 2) quantify this influence and 3) test the device's practicability.
Four complete test sequences were accomplished under highly standardized, reproducible and controllable "semi-laboratory" conditions on homogenous sandy substrate, deposited on an area of 7.6 x 60 m with uniform inclination in Wageningen University's Irrigation Tunnel. Due to the homogenous substrate with sufficient dimension so as to act as a natural body of soil, this setup allowed the highest possible reproducibility combined with closest to nature circumstances. Tests were performed on the same plot in the following order: 1) Single wind test run (10 min), 2) single rainfall test run on dry soil (30 min), 3) single rainfall test run on moist soil (30 min), 4) simultaneous wind and rainfall test run (30 min). Between test runs a 30 min break was included for remounting of sediment catchers and to allow initial drainage of soil. For investigation of wind-driven rain, the third and the fourth test run were compared.
Comparing test runs in combination with wind to runs without wind, eroded material increased from 98 % to maximum values of up to 1108 %, whereas the increase in runoff was considerably lower (increase of 11 % to 66 %). Regarding sediment concentration, an increase from 46 % to 894 % can be observed.
The results are important regarding both, the immense impact of wind induced rain on the soil erosion processes and the reliability of the experimental setting. Furthermore, the experiments enable a clear process observation and quantification in the field.