Geophysical Research Abstracts
Vol. 16, EGU2014-12859, 2014
EGU General Assembly 2014

The relevance of wind-driven rain for future soil erosion research

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The influence of wind on falling raindrops and its potential to alter soil erosion rates was already proposed during the 1960s, but never really reached broad awareness in the soil erosion research community. Laboratory investigations over the last 15 years confirmed earlier findings and have proven that wind modifies the characteristics of falling raindrops in many ways. Most importantly, the impact angles and impact frequencies, as well as the drop velocities, drop sizes and hence the kinetic energy are modified. Consequently, the results of laboratory experiments on highly disturbed, loose, and mostly sandy substrates indicate that soil detachment and transport/splash distances of particles increase under the influence of wind. However, these experiments cannot reflect the complexity of naturally developed soils and a direct transfer of these findings to field conditions is therefore limited. So far, only a few field studies have reported increased erosion rates due to splash drift or increased runoff by wind-driven rain. Because of the lack of simultaneous reference measurements without the influence of wind, these studies were not able to discriminate between the different processes and thus couldn not clearly prove the relevance of wind-driven rainfall.
Despite all these findings, the awareness of this phenomenon is, in our opinion, still limited. Almost all rainfall simulations exclude the factor of wind as a disturbance to reach more representative rainfall conditions on the plot. We think, that among other reasons, this underestimation of the influence of wind could be due to the absence of an adequate measurement device to simulate these processes and additionally, due to the fact that the relevance of wind-driven rain in a landscape context has not yet been proven. To overcome this lack of a useful device, and to take the research from the laboratory to the field on real soils again, the first portable wind and rainfall simulator was developed within this PhD-project. By measuring soil erosion rates on the same plot, both with and without wind application, the influence of wind on soil detachment and erosion rates can now clearly be determined. Field experiments with the Portable Wind and Rainfall Simulator, which were carried out in Andalusia (Spain), in Wageningen (The Netherlands), and in Foulum (Denmark) during and within 3 years after finishing the PhD-project, aimed to improve the knowledge of processes involved, and to show the relevance of wind-driven rainfall erosion.

The results indicate that the influence of wind depends on the complexity of the landscape. In an environment with homogenous conditions (loose sand mixture) and only a few variable factors (i.e. no vegetation, no surface roughness, no slope), like the test site in Wageningen, the increase of erosion rates due to the influence of wind could be seen in almost every test run. This clear influence of wind decreased with the amount of involved factors from agricultural soils in Denmark with a homogenous sandy texture and steep slopes, to highly degraded abandoned/fallow land with thick soil crusts and a clay-silt texture in Andalusia. The results obtained by “simple” rainfall simulations, therefore, clearly underestimate soil erosion rates, depending on the environment. This could, in our opinion, have strong implications for future soil erosion research and modelling.