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Soil erosion rates by wind-driven rain from a sandy soil in Denmark

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Soil erosion by wind and water is able to cause severe soil loss from agricultural fields. Laboratory studies in recent years have shown that wind most probably has an increasing effect on soil erosion rates by water. However, field studies have so far not been able to quantify and proof this assumption explicitly. Especially the differentiation between the influence of windless and wind-driven erosion seems to be the major issue. The objectives of this study were, therefore, to explicitly investigate the importance of wind-driven rain in relation to erosion rates without the effect of wind by applying a newly developed Portable Wind and Rainfall Simulator (PWRS) that is able to simulate the processes both separately and simultaneously.

The PWRS was used on bare sandy soil near Viborg, Denmark. Prior to simulation the soil was ploughed and after consolidation harrowed to create surface structures and roughness representing typical conditions after seed bed preparation. To facilitate the separation of specific influences by wind-driven rain and to avoid systematic errors a defined order of four consecutive test runs was established: 0) single wind test run for 10 min, 1) single rainfall test run on dry soil, 2) single rainfall test run on moist soil, 3) simultaneous wind and rainfall test run (wind-driven rainfall). Each rainfall simulation lasted for 30 minutes with a 30 min break in between to allow for initial drainage of the soil and for remounting sediment catchers. By utilizing a gutter in combination with wedge-shaped sediment traps it was possible to separate between splash and runoff erosion from the 2.2 m2 plot.

The results show a wide range of soil detachment raging from zero up to more than 500 g m^{-2} in 30 minutes. Five out of nine test sequences support the theory that wind-driven rain causes more erosion than windless rain. The relation between the two processes is therefore not as clear as expected and seems to be dominated by the natural variability of soil and surface conditions. Therefore more tests are needed to be able to fully understand and quantify the relation between windless and wind-driven rain.