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Estimation of nutrient movement caused by wind erosion on chernozem soil with wind channel experiments

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One of the most important soil degradation process is wind erosion.
There are several studies all around the world, including Hungary to quantify the amount of soil eroded by wind. Estimation of eroded nutrients (humus, nitrogen, phosphorus, potassium) plays more and more important role in these investigations. Hungarian studies were focused on sandy areas in spite of the high endangered chernozem areas. Our chernozems of high quality can be struck by wind erosion mainly in springtime when the vegetation cover is quite low. This study is focused on chernozem soils in Hungary in order to determine the movement and loss of soil nutrients by wind.
The study areas were chosen in the SE part of Csongrád County, near the villages Csanádpalota, Csordakút and Apátfalva where we can find chernozem soils of high quality.
300-350 kg of soil samples were collected from the upper 5 cm of each study plot in July 2008 after harvest. All soil samples are chernozems of good quality and they have got silty loam texture with a humus content between 1,4-1,8 %. Experiments were performed in the wind channel of the University of Debrecen on the collected soil samples.
Samples were put into 30x50 cm holder and they were blown by wind at 4 different speeds (12, 13, 14 and 15 m/s) in a 12,3 m long wind channel. There were 3 parallel experiments for each soil sample, all of which took 15 minutes. Besides measuring the soil mass before and after the experiments, the mass of accumulated soils collected from the lee side of the holder and from sediment traps, the critical wind speed and the wind profile were also measured. Sediment traps were placed at 0-10 cm and 10-40 cm heights. From the collected samples the next parameters were measured: particle size distribution, pH, clay, carbonate, salt, humus, phosphorus (AL-P2O5), nitrogen and potassium (AL-K2O) content.
Soil mass eroded from the sample holder was between 0,5 and 3,4 kg and they grew with wind speed.
Only small portion of the total eroded soil was sedimented after the holder, most part of the moving soil was collected in the lower trap (0-10 cm) and the upper trap (10-40 cm) received only its 20-30 %. There are important differences between the structure and nutrient content of the soils sedimented in these different places: sediments after the holder contain bigger aggregates with high clay and silt content, while sand of weak structure was caught in the two traps. Therefore the humus content is much higher after the holder, it can reach even 2 %.
The amount of eroded nutrients per hectare was calculated based on the weighted average of the nutrient content in the two sediment traps, area of the sample holder and the total amount of eroded soil. The results show that the amount of eroded humus can reach 3 t/ha, phosphorus (P2O5) loss can exceed 60 kg/ha, potassium (K2O) loss is higher than 70-90 kg/ha and the amount of nitrogen is between 280-340 kg/ha at the highest wind speeds.