Geophysical Research Abstracts
Vol. 17, EGU2015-12308, 2015
EGU General Assembly 2015

Nutrient and dust enrichment in Danish wind erosion sediments for different tillage directions

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More than 80% of the soil types in Denmark have a sandy texture. Denmark is also subject to strong offshore and onshore winds, therefore, Danish soils are considered especially vulnerable to wind erosion. Where conventional tillage operations are applied on poorly aggregated soils, tillage ridges are more or less the only roughness element that can be used to protect soils against wind erosion until crop plants are large enough to provide sufficient breaks. Since wind erosion is a selective process, it can be assumed that increasing erosion rates are associated with increasing loss of dust sized particles and nutrients. However, selective erosion is strongly affected by the orientation and respective trapping efficiency of tillage ridges and furrows. The main objective of this study, therefore, was to determine the effect of tillage direction on nutrient mobilization by wind erosion from agricultural land in Denmark. In order to assess the relationship between the enrichment ratio of specific particle sizes and the amount of eroded nutrients, three soils with loamy sand texture, but varying amounts of sand-sized particles, were selected. In addition, a soil with slightly less sand, but much higher organic matter content was chosen. The soils were tested with three different soil surface scenarios (flat surface, parallel tillage, perpendicular tillage) in a wind tunnel simulation.
The parallel tillage operation experienced the greatest erosion rates, independent of soil type. Particles with D50 between 100-155 μm showed the greatest risk of erosion. However, due to a greater loss of dust sized particles from perpendicularly tilled surfaces, this wind-surface arrangement showed a significant increase in nutrient enrichment ratio compared to parallel tillage and flat surfaces. The main reason for this phenomenon is most probably the trapping of larger particles in the perpendicular furrows. This indicates that the highest rate of soil protection does not necessarily coincide with lowest soil nutrient losses and dust emissions. For the evaluation of protection measures on these soil types in Denmark it is, therefore, important to differentiate between their effectivity to reduce total soil erosion amount, dust emission, and nutrient loss.