The transport of microplastic on agriculture soils via soil erosion

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Agricultural soils play a key role as sink of microplastic (MP) coming from different sources, especially via the application of sewage sludge, compost, plastic mulch films, and tire ware. However, the effectiveness of this sink might be substantially reduced in areas subjected to water erosion. The aim of this study is to determine the transport behavior of MP during water erosion events on arable land. More specifically it is analyzed if MP is preferentially transported or behaves more conservative as attached to soil minerals and/or encapsulated in soil aggregates. A series of rainfall simulations were performed over 1.5 years on two plots at two test sites representing different intensively used soils (silty loam and loamy sand) in Southern Germany. The plots (4.5 m x 1.6 m) were spiked with microplastic (high density polyethylene) consisting of two different size fractions, fine MP (MP<sub>f</sub>, 53-100 μm) and coarse MP (MP<sub>c</sub>, 250-300 μm) incorporated into the topsoil (< 10 cm). The results clearly underline the selective nature of MP erosion leading to an enrichment ratio of MP in the eroded sediments of the loamy sand plot of 3.82 to 7.86, compared to an enrichment ratio from the silty loam plots of 1.41 to 5.29. Interestingly, there was no significant difference in enrichment ratios between MP<sub>f</sub> and MP<sub>c</sub>. Over time, an increasing connection between MP and soil particles could be observed. During the first rainfall simulation only 12% (MP<sub>c</sub>) and 34-49% (MP<sub>f</sub>) of the eroded plastic particles were connected to mineral particles or soil aggregates, while during the last simulation 1.5 years later about 31-47% (MP<sub>c</sub>) and 57-67% (MP<sub>f</sub>) of the eroded particles were bond to the soil matrix. Overall, our results indicate a strong dependency of the erosion transport behavior of MP depending on soil characteristics and time since application, while surprisingly we found little effect of MP size.