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The use of a settling tube to study aggregates breakdown dynamics and predict the fate of soil organic matter

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The detachment of soil particles by raindrop splash is usually regarded as an important first step in soil erosion and sediment transport. The detached material can then be transported by both splash erosion and overland flow. As an important substance which can significantly influence the global Carbon (C) cycle and climate change, soil organic carbon (SOC) is moved by these erosion processes. Most detached soil material is aggregated. The properties of aggregates therefore affect the settling velocity and thus transport distance and redistribution of eroded SOC in terrestrial and aquatic environments. Recent research recognized the importance of settling velocity as an independent parameter in the soil erosion models, but it is very difficult to quantify the settling velocity of the aggregates from their sizes due to variations in their density, shape, roundness and pore-space. It is therefore necessary to fully understand the dynamics of aggregate breakdown for determining the settling velocity distribution of eroded soil particles when studying sediment movement and aggregate bound SOC transport.
In this study, two agricultural soils, a poorly aggregated sandy soil from Denmark and a well aggregated silt loam soil from Switzerland were first subjected to the rainfall of 30mm h-1 lasting between 15 and 90 minutes to induce aggregate breakdown. Subsequently, a settling tube was used to fractionate the aggregates according to their likely transport distance after breakdown. The results show that as the rainfall duration increased from 15 minutes to 90 minutes, the proportion of aggregates potentially being transported to the aquatic system tripled on the loam, but hardly changed on the sand. However, although the proportion of aggregates likely to be transported to watercourses is significantly higher for the silt loam soil compared to the sandy soil, the proportion of SOC capable of being transported to the watercourses is similar. The reason for this balancing is the much greater SOC content of the slow-settling fraction of the sand than of the silt loam. Nonetheless, these results indicate that the aggregation is an important factor that can significantly influence the transfer of SOC from hill slopes to watercourses.