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Mobilisation of Amorphous and Dissolved Silica on Small Agricultural Plots

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In recent years awareness has grown that biogeochemical cycles are strongly affected by processes occurring in the critical zone. Global carbon dynamics, for instance, may be affected by soil erosion and deposition processes that affect carbon dynamics within the critical zone. Silica is another element of which the cycling may be strongly influenced: weathering is a major source of dissolved silica (DSi) that may be transformed to amorphous silica (ASi) through reprecipitation in the soil and/or in vegetation. As Si is a crucial nutrient for diatoms, which are a base component for a well-balanced food-system in estuarine and coastal zones, it is important to understand how anthropogenic modifications of critical-zone processes, including agricultural erosion, may affect global Si cycling. According to our knowledge, studies on the effects of erosion and deposition on Si cycling and mobilisation are almost nonexistent.

In this paper we report the first results of a series of rainfall simulation experiments that were set up to (i) quantify Si mobilisation through erosion at the small plot scale and (ii) investigate to what extent Si mobilisation by erosion may be dependent on crop type and tillage technique. We quantified ASi and Dsi fluxes during rainfall experiments on small scale plots ($\sim$0.73m^2). Experiments are conducted for various crop and tillage types.

Our results indicate that soil erosion mobilises significant quantities of ASi and DSi. Overall ASi mobilisation is more important: ca. 80% of total silica export is ASi, only 20% of the Si is exported as dissolved silica. There is a near-linear relationship between ASi and sediment concentration in the runoff: tillage technique and crop type have only a secondary influence. Thus, in a first approximation, a good estimate of ASi mobilisation through erosion can be made if total sediment mobilisation can be correctly assessed.