

Publication

A step towards a holistic assessment of soil degradation in Europe: Coupling on-site erosion with sediment transfer and carbon fluxes

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Soil degradation due to erosion is connected to two serious environmental impacts: (i) on-site soil loss and (ii) off-site effects of sediment transfer through the landscape. The potential impact of soil erosion processes on biogeochemical cycles has received increasing attention in the last two decades. Properly designed modelling assumptions on effective soil loss are a key pre-requisite to improve our understanding of the magnitude of nutrients that are mobilized through soil erosion and the resultant effects. The aim of this study is to quantify the potential spatial displacement and transport of soil sediments due to water erosion at European scale. We computed long-term averages of annual soil loss and deposition rates by means of the extensively tested spatially distributed WaTEM/SEDEM model. Our findings indicate that soil loss from Europe in the riverine systems is about 15% of the estimated gross on-site erosion. The estimated sediment yield totals $0.164 \pm 0.013 \text{ Pg yr}^{-1}$ (which corresponds to $4.62 \pm 0.37 \text{ Mg ha}^{-1} \text{ yr}^{-1}$ in the erosion area). The greatest amount of gross on-site erosion as well as soil loss to rivers occurs in the agricultural land (93.5%). By contrast, forestland and other semi-natural vegetation areas experience an overall surplus of sediments which is driven by a re-deposition of sediments eroded from agricultural land. Combining the predicted soil loss rates with the European soil organic carbon (SOC) stock, we estimate a SOC displacement by water erosion of 14.5 Tg yr^{-1} . The SOC potentially transferred to the riverine system equals to 2.2 Tg yr^{-1} (15%). Integrated sediment delivery-biogeochemical models need to answer the question on how carbon mineralization during detachment and transport might be balanced or even off-set by carbon sequestration due to dynamic replacement and sediment burial.

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