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Global Soil Erosion Modelling in the Context of Climate Change

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It is widely recognized that accelerated soil erosion has been a major threat to sustainable agriculture across the globe for many decades. Human activities like deforestation and agricultural practices induce land-use changes that can trigger soil erosion on large scales and lead to irreversible changes in the landscape. By altering the landscape however, soil erosion also influences the global carbon and nutrient cycles, which play an important role for the current climate change. How the carbon and nutrient cycles are affected through all stages of soil erosion (soil detachment, sediment transport and deposition) is not well known yet. Furthermore, the global population growth and climatic changes itself can exacerbate the effects of soil erosion. It is therefore important to investigate soil erosion and its controlling factors including global climate dynamics.
A study on soil erosion at a global scale requires a model that can represent soil erosion dynamics at this scale for different soil types, climatic and land use conditions. Here we present the first step in modelling soil erosion on a 0.5 by 0.5 degree grid by calculating the soil loss for each gridcell. This is done by the implementing the Revised Universal Soil Loss Equation (RUSLE) model, which is widely used for soil erosion estimation at different spatial scales. However its implementation on global scale together with global datasets of soil characteristics, topography, land-use and climate is still relatively new. The RUSLE model is based on a large set of empirical data on soil erosion gathered under different conditions in the United States. In this model the soil loss is calculated by a linear regression formula consisting of the following factors: rainfall erosivity, soil erodibility, topography, cover-management and conservation practice. Each factor plays a specific role in the estimation of soil loss. The current study discusses the implementation of the RUSLE model and its erosivity factors on global scale by generalizing from the United States to all continents. An outlook on this study is to couple the RUSLE model to the dynamical global vegetation model JSBACH or earth system model MPI-ESM to investigate the effects on the carbon and nutrient cycles in full interaction with the climate.