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The biogeochemical footprint of agricultural soil erosion

Gerard Govers (1), Kristof Van Oost (2), and Zhengang Wang (2)

(1) K.U.Leuven, Earth and Environmental Sciences, Heverlee, Belgium (gerard.govers@ees.kuleuven.be), (2) Université Catholique de Louvain, TECLIM, Louvain-la-Neuve, Belgium (kristof.vanoost@uclouvain.be)

Global biogeochemical cycles are a key component of the functioning of the Earth System: these cycles are all, to a varying extent, disturbed by human activities which not only has dramatic consequences for the global climate but also for the acidity of the world's oceans. It is only relatively recently that the role of lateral fluxes related to surface water movement and soil erosion and deposition (and the way those fluxes are modified by human action) is explicitly considered by the scientific community.

In this paper we present an overview of our present-day understanding of the role of agricultural soil erosion in the global cycles of carbon, nitrogen, phosphorous and silica. We discuss the major processes through which erosion affects these global cycles and pay particular attention to the knowledge gaps that prevent us from accurately assessing the impact of soil erosion on global biogeochemical cycling at different temporal scales.

Furthering our understanding (and better constraining our estimates) will require progress both in terms of model development and process understanding. Research needs can be most clearly identified with respect to soil organic carbon: (i) at present, large-scale soil erosion (and deposition) models are poorly constrained so that the amount of carbon mobilised by erosion (and its fate) cannot be accurately estimated and (ii) the fate of soil organic carbon buried by deposition or delivered to river network is poorly understood. Uncertainties for N, P and Si are larger than those for C as we have less information on the amount of these elements stored in agricultural soils and/or do not fully understand how these elements cycle through the soil/plant system.

Agricultural soil erosion does not affect soil functioning through its effect on biogeochemical cycling. Erosion directly affects soil hydrological functioning and is likely to affect weathering processes and soil production. Addressing all these issues requires the combination of a wide range of approaches, allowing not only to assess current processes, but also their cumulative effects over long time spans.