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Temporal evolution of human-induced carbon burial in terrestrial environments

S. Doetterl (1), K. Van Oost (1), T.A. Quine (2), J. Six (3), and B. Van Wesemael (1)

(1) Department of Geography, Catholic University of Louvain, Louvain-la-Neuve, Belgium (sebastian.doetterl@uclouvain.be), (2) Department of Geography, University of Exeter, Exeter, United Kingdom, (3) Department of Plant Sciences, University of California, Davis, U.S.A.

Soil organic carbon (SOC) is recognized to be an important parameter for the maintenance of soil fertility. Associated with contemporary discussions on Global Climate Change, carbon cycling and the influence of fluxes between atmospheric and terrestrial carbon pools, the importance of research on factors controlling SOC contents has even grown.

In recent studies, geomorphologic processes (soil erosion and sedimentation) and site attributes (slope steepness and land use) have been postulated to be the driving factors in human-impacted landscapes for decomposition and stabilization of SOC. Hence, depositional environments are assumed to be strong sinks for terrestrial carbon due to burial of former topsoil horizon SOC in deeper soil layers, leading to reduced decomposition rates. This must be taken into account in estimation of terrestrial carbon stocks and asks for modification of carbon models, considering erosion and sedimentation processes via including lateral and vertical SOC fluxes in time.

In order to accurately quantify the human-induced carbon sink there is a need to both (I) increase our understanding of carbon cycling processes in complex terrains under the impact of soil redistribution and (II) improve our estimates of the amount of carbon being laterally transferred and buried in terrestrial environments. Current estimates of continental or global carbon fluxes largely depend on unverified assumptions and model applications that ignore lateral fluxes. The main objective of this study is to quantify the temporal and spatial evolution of carbon fluxes at the continental (and global) scale. We present an overview on the development of colluvial soil formation on large spatial scales, taking into account historical and present human induced erosion processes as well as global land use change. Based on this information, we present an analysis of the temporal evolution of SOC burial. Furthermore, we give an outlook on our future work which aims to link the large scale analysis mentioned above to detailed regional scale studies. The latter will focus on the changes of chemical and physical characteristics of soils in agricultural landscapes following slope transects and their influence on the distribution as well as the amount and quality of relocated and stabilized SOC.