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# Carbon emissions as a result of land use change and accelerated soil erosion: perspectives in time & space.

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Carbon emissions as a result of anthropogenic land use have drastically altered the global C cycle. Analyses reported that land use change has released 156 Pg C from vegetation and soils to the atmosphere in the period 1850-2000, equivalent to c. 50% of fossil fuel emissions. More recently, longer-term analysis of human-induced land cover change have highlighted the importance of past land use changes, with estimates of pre-industrial Holocene carbon emissions ranging between 50 and 357 Pg C. Current global vegetation models represent well the net terrestrial C exchange from both vegetation and soils accompanying land use change. In contrast, C exchange associated with accelerated soil erosion following the conversion of land to agricultural use is not accounted for. Large amounts of C have been exposed to mineralization and burial as a result of agricultural erosion and deposition but its significance for both current and past fluxes of carbon due to changes in land use remains poorly quantified. Here, we present an overview of the key controls on soil erosion-induced changes in C exchange between the soil and the atmosphere. We provide evidence of how erosion processes increase the stabilization potential of soils by advecting mineral surfaces through the soil column. Accelerated erosion provides fresh mineral surfaces to the biologically active soil layer where it can stabilize organic matter inputs from plants at sites of erosion. In combination with the deep burial of allochthonous and autochtonous carbon and the inhibited decomposition upon burial, this acts as a sink mechanism. The conditions under which accelerated erosion leads to the chemical and physical breakdown of soil and a biomass reduction following soil degradation, resulting in a net source are also identified. We also present the integrated biotic flux of carbon for the Holocene as a result of both anthropogenic land use change and accelerated erosion for a large coupled upland-colluvial-floodplain system in Belgium. We quantify the spatial and temporal dynamics of sediment and carbon sources and sink using evidence from soil truncation studies, radiocarbon dating and soil databases in combination with soil-vegetation models. Based on this assessment, we discuss the uncertainties surrounding net C exchange and information gaps that hamper the quantification of the linkages between accelerated erosion and the C cycle in a temporal framework.