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Connecting the cycles: impact of farming practices, Carbon and nutrient erosion on GHG emissions

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This study focuses on identifying links between GHG emissions, soil management and soil erosion that are not considered in the commonly applied emission calculations associated with farming and soil erosion. The role of agriculture in generating GHG emissions through the use of fertilizers and fossil fuels is well documented. The negative impacts of soil erosion on agricultural land and its productivity have also been studied extensively. The lateral movement of soil through terrestrial ecosystems has also been recognized as a significant flux of C within the global C cycle. Soil erosion removes approximately 0.5 Gt of C per year from agricultural land. Much of this C is deposited in the landscape, effectively burying the organic matter from the atmosphere and taking it, at least for an unspecified time, out of the C exchange between soil and atmosphere. Such calculations raise the notion that soil erosion generates an unintentional benefit for climate, owing to the long-term burial of soil organic Carbon. But limiting the assessment of the impact of soil erosion on climate change to organic carbon burial ignores, apart from economic and social damages, the coupling between biogeochemical cycles. For example, the eroded nitrogen has to be replaced, at least in part by artificial fertilizers, to maintain soil fertility. At this point the sediment, Carbon and nitrogen cycles meet, because the production of fertilizer generates greenhouse gases. The production of one ton of fertilizer generates on the order of 850 kg of carbon dioxide. Applying this number to the 0.5 GT C erosion estimate, the amount of nitrogen lost owing to erosion each year yields carbon dioxide emissions of 0.02–0.04 Pg per year. These emissions correspond to 15–30% of the organic carbon buried owing to soil erosion.

In this presentation, the full complexity of biogeochemical cycling on agricultural land is explored and connections between cycles which require consideration for a full GHG emission balance of soil erosion on agricultural land are identified. A first analysis of the data available on a full account of erosion-related emissions is presented. Apart from identifying a potentially significant source of GHG emissions associated with soil erosion that has not been considered for impact assessment so far, the study also shows that separating emission accounting between the industry producing the fertilizer and the agricultural sector, i.e. the grey emissions associated with farming, does not reflect the actual mechanism between erosion, farming practices and emissions.