Erosion and climate

To the Editor — The calculations offered by Quinton *et al.*[1] raise the unfortunate 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 carbon and nitrogen cycles meet, because the production of fertilizer generates greenhouse gases; the production of one ton of fertilizer in the United States generates more than 850 kg of carbon dioxide[2]. Applying this number to the estimate by Quinton *et al.* of the amount of nitrogen lost owing to erosion each year[1] yields carbon dioxide emissions of 0.02–0.04 Pg yr^{-1}. These emissions correspond to 15–30% of the organic carbon buried owing to soil erosion[1,3]. Obviously the full complexity of biogeochemical cycling on agricultural land is not reflected by the crude calculation above. However, the example illustrates that all greenhouse gas fluxes affected by agriculture should be considered when assessing the impact of soil erosion on global biogeochemical cycles and climate. ❐

References
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Authors' reply — We did not state that soil erosion generates an unintentional benefit for climate. Instead, we suggested that erosion-induced changes in the carbon cycle need to be taken into account when developing management schemes to maximize carbon storage in soils. However, we agree that eroded nitrogen needs to be replaced if agricultural production is to be sustained, and that this will come at a cost both to atmospheric greenhouse gas levels and the economy. We concur that determining the impact of farming and land use on greenhouse gas budgets is an important next step in the development of carbon inventories.

We did, however, consider the coupling between biogeochemical cycles, albeit not for the entire agricultural system. We explicitly considered the impact of soil erosion on the fate of nitrogen, phosphorus and carbon in agricultural landscapes. By doing so we believe that we have contributed towards the development of the more holistic perspective of soil erosion proposed by Kuhn. Such a perspective should not be limited to biogeochemical cycling: we are very aware of the economic and social damage that soil erosion may cause, hence we highlighted in our paper that "erosion threatens the sustainability of food production and human welfare in many parts of the world". ❐

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