Land unlikely to become large carbon source

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To the Editor — Increasing CO2 concentration and rising temperatures are both expected to have important impacts on plant productivity. Models used to simulate how terrestrial carbon stocks change in response to climate change, such as those used in the Coupled Model Intercomparison Project Phase 5 (CMIP5), do not account for how changes in the availability of nutrients such as nitrogen or phosphorus may limit net primary production. Wieder et al. Point out that the CMIP5 models overestimate future land carbon storage[1]. Although this finding is in line with earlier work[2,3], we disagree with their conclusion that nutrient limitation of net primary production could cause terrestrial ecosystems to transition from being a net carbon sink to a large carbon source.

Several feedback processes not considered by Wieder et al. make it unlikely that land will become a carbon source[2,3]. First, Wieder et al. assume that warming stimulates decomposition of soil organic carbon but does not affect the mineralization of nutrients from soil organic matter. This assumption maximizes the effect of nutrient limitation on land carbon storage under warming. It contradicts soil-warming experiments showing enhanced mineralization in a range of ecosystems, which potentially compensates soil carbon losses by stimulating plant productivity due to increased nutrient availability[4]. Changes in mineralization, as well as additional processes governing the recycling of nutrients, pose a large source of uncertainty in the amount of nutrients available for the build-up of new biomass. Ithe case of phosphorus (P), changes in dust deposition and other external inputs (the only source of P considered by Wieder et alare of minor importance for the terrestrial carbon balance on decadal to centennial timescales, since more than 95% of annual net primary productivity is supported by recycled P rather than P from external sources[2,5]. The amount of P available for the build-up of new biomass accounted for by Wieder et al. is of the same order of magnitude as estimates of present-day labile inorganic P concentration in soils, a conservative estimate of P availability[6]. In addition, under availability in the future. However, under the conditions of strong warming evaluated by Wieder et al., the amount of new P from weathering can be expected to double by the end of the twenty-first century. These two examples illustrate how uncertain the availability of P is. Although Wieder et al. discuss these processes, they either neglect them in their calculations or provide no uncertainty range.

Currently, land ecosystems absorb a quarter of anthropogenic CO2 emissions. Potential turning of this sink into a source conveys a strong warning message to policymakers. Such a message should not be based only on uncertain assumptions regarding nutrient dynamics in ecosystems and upper-end warming scenarios.

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