The role of plant regrowth in recent enhancement of terrestrial carbon uptake

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Attributing drivers of net carbon uptake in detail leads to clarification of causes for the recent enhancement of carbon dioxide (CO_2) uptake by the terrestrial biosphere. The increasing strength of the land uptake in the 2000s has been attributed so far to a stimulating effect of rising atmospheric CO_2 on photosynthesis (CO_2 fertilization). However, it is still arguable whether the CO_2 fertilization is a dominant cause for the recent enhancement of CO_2 uptake because, in addition to the level of atmospheric CO_2, the terrestrial biosphere has undergone historical changes through land use and management. CO_2 emissions resulting from LUC activities account for ~9% of the total global anthropogenic CO_2 emissions, therefore changes in LUC could affect the course of the net sink-source pattern of CO_2 over time.

Here using an ensemble of biosphere models, we show a decadal-scale carbon uptake enhancement is induced not only by CO_2 fertilization, but also an increasing uptake by plant regrowth from past land use changes (LUC), with its effect most pronounced in eastern North America, southern and eastern Europe, and southeastern temperate Eurasia. Our analysis indicates that ecosystems in North America and Europe have established the current productive state through regrowth over a half-century, and those in temperate Eurasia are still in a recovering stage from active LUC in the 1980s. As the strength of model representation of CO_2 fertilization is still in debate, plant regrowth might have a greater potential to sequester carbon than indicated by this study.

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