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Science 17 September 1999:
 Vol. 285, no. 5435, p. 1849
 DOI: 10.1126/science.285.5435.1849i

LETTERS

Effect on the Biosphere of Elevated Atmospheric CO₂

The report "Net primary production of a forest ecosystem with experimental CO₂ by enrichment" by E.H. DeLucia *et al.* (14 May, p. [1177](#)) provides excellent and much-needed experimental work on the responses of the terrestrial biosphere to elevated atmospheric carbon dioxide (CO₂). However, we are concerned about the report's last statement (also appearing in the abstract), which extrapolates measurements of net primary production (NPP) from this one experiment to the world's forests as a whole, suggesting that they could absorb as much as 50% of the projected fossil fuel emissions of CO₂ in 2050. This projection gives a misleading, perhaps erroneous, picture of the role of the terrestrial biosphere in the global carbon cycle.

First, NPP is not the appropriate measurement to apply when considering the net uptake (or release) of CO₂ by the terrestrial biosphere on a biome or larger spatial scale and over several decades. The most appropriate concept is net biome production (NBP) ([1](#)), which includes not only NPP, but also losses of carbon resulting from heterotrophic respiration, fires, insect-induced mortality, logging, and other natural and human-induced disturbances ([2](#)).

In contrast to global terrestrial NPP, which is about 60 picograms of carbon per year, global terrestrial NBP is about ± 1 or 2 picograms per year.

Second, there is considerable difficulty in extrapolating up in time and space from a single experiment based on a step-change in CO₂ concentration over a young, rapidly growing stand of trees, as noted by the authors of the report immediately before the final statement.

Third, applying the same methodology for extrapolation as used in this report, we conclude that the world's forests should now be taking up at least 3 picograms of carbon per year of fossil-fuel emissions. This is significantly higher than current estimates of terrestrial carbon sequestration [for example, ([3](#))] and is inconsistent with atmospheric inverse calculations, as well as with estimates of oceanic carbon uptake.

In the current, post-Kyoto international political climate, scientific statements about the behavior of the terrestrial carbon cycle must be made with care,

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especially extrapolations from stand-level experiments or observations.

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Response

NPP is the difference between total, annually integrated photosynthesis (gross primary production) and plant respiration and therefore represents the rate of carbon uptake from the atmosphere by ecosystems (1). By assuming that all forests of the world are similar to our young, fast-growing stand of loblolly pine, we attempted to constrain an estimate of the maximum net increment of NPP when the atmosphere contains 560 parts per million of CO₂. Our value for forest uptake, 50% of the anticipated CO₂ emissions from fossil fuels in the year 2050, indicates that forests will not solve the global warming problem for us. And, as Bolin *et al.* indicate, actual long-term carbon storage will be much less than NPP,



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owing to the activity of soil microbes, fires, human land-use changes, and so forth, which act to return CO₂ to the atmosphere.

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Science. ISSN 0036-8075 (print), 1095-9203 (online)

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