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The role of nitrogen in terrestrial biosphere responses to climate change and CO2 increase

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State-of-the-art models of the terrestrial biosphere, as used for the IPCC reports, project that land ecosystems will sequester a considerable proportion of the carbon dioxide released by human activities in the decades to come (Cramer et al., 2001). This uptake would counteract the effect of anthropogenic emissions on the climate system, and thus slow the rate of human induced climatic change. Projections from these models are disputed, however, because of their limited representation of carbon-nutrient feedbacks. For instance, Hungate et al. (2003) argued, on the basis of simple ecophysiological assumptions, that the carbon sequestration projections of these models are significant overestimates because they do not account for nutrient limitation of vegetation growth.

We critically investigate the assumptions made by Hungate et al. and review the underlying model results of Cramer et al. using understanding gained from experimental studies. To further assess the degree to which the terrestrial nitrogen cycle constraints potential carbon sequestration, we have developed a new process-based model, ORCHIDEE-N, incorporating the latest understanding of nitrogen feedbacks in terrestrial ecosystems. Potential constraints on ecosystem response to future changes in climate and atmospheric CO_2 are investigated and conclusions drawn with respect to the controversial aspects of existing model projections.

Literature:

Cramer, W., A. Bondeau, et al. (2001). "Global response of terrestrial ecosystem structure and function to CO_2 and climate change: results from six dynamic global vegetation models." Global Change Biology 7(4): 357-373.

Hungate, B. A., J. S. Dukes, et al. (2003). "Nitrogen and Climate Change." Science 302: 1512-1513.