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How robust are responses of carbon-nitrogen cycle models to increasing atmospheric [CO_2] and climatic changes?

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A number of recent studies have demonstrated the importance of considering nitrogen dynamics for projecting the responses to the terrestrial carbon cycle to increasing atmospheric [CO_2] and climatic changes [1-4]. However, there are considerable differences in the global and regional responses of individual models concerning the strength and even the sign of the effect of N dynamics of the dynamics of the terrestrial carbon cycle. Here, the implications of alternative hypotheses on key nitrogen cycle characteristics that determine vegetation responses are tested to assess the reliability of the modelled responses. For this purpose, the terrestrial biosphere model O-CN model, derived from the land-surface scheme ORCHIDEE of the IPSL Earth system model, is used in different configurations, namely the elasticity of the plant's C:N stoichiometry, and the capacity of vegetation to increase biological nitrogen fixation as a function of N demand and C excess.

The alternative hypotheses result in substantially different projected land C storage by the year 2100. However, they do not prevent i) that there is a significant reduction of the net land C storage resulting from CO_2 fertilisation compared to the model version not accounting for terrestrial N dynamics; and ii) that on the global scale the limiting effect of N dynamics on the CO_2 fertilisation response is stronger than the stimulating effect of increased N release from soil organic matter decomposition in a future warmer climate.

References:

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