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Biogeosciences
Discussions

Interactive comment on "Nutrient limitation reduces land carbon uptake in simulations with a model of combined carbon, nitrogen and phosphorus cycling" *by* D. S. Goll et al.

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We thank the reviewer and fully agree that an important aspect of plant acclimation to a changing environment is the flexibility in stoichiometry. However, the processes underlying such flexibility are poorly understood. Also the constraints on flexibility are not yet quantified. Therefore, we think that it is too preliminary to introduce stoichiometry dynamics into the model.

However, in response to the reviewer suggestion, we developed a simple concept to quantify the effect of flexible stoichiometry on land C cycling. We performed additional sensitivity simulations (CP-FLX and CN-FLX) in which we vary the stoichiometry of

newly formed plant material by linearly increasing the CP and the CN ratio of plant compartments with nutrient limitation up to 50%, respectively. In addition, the efficiency to retranslocate nutrients prior leaf shedding increases with nutrient limitation as we increase the CP ratio of shedded leaves in a similar manner. As our model does not account for effects of a lower nutrient content of leaves on productivity, these simulations are rather unrealistic as we overestimate the effects of plant acclimation.

The differences in land C cycling between these simulation and the standard simulation are marginal (Figure 1), although the global means of the C to nutrient ratios of vegetation increase up to 9%. The increase in the CN ratios of the green and the wood pool (Figure 2) are high compared to the increase of about 1% in the CN ratio of wood and leaves in another CN model with flexible stoichiometry (Esser et al., 2010). Our new results support the main conclusions stated in the manuscript about the most important processes controlling N and P limitation. Especially, as we overestimate stoichiometric acclimation in these new simulations.

We are ready to include these results and the results from the simulation with PFT-specific CNP ratios into our manuscript if reviewers and the editor find them useful.

Figure captions:

Figure 1. The simulated change in land carbon storage under the SRES A1B scenario. Shown arethe 10 yr mean of soil temperature (a) , the CO2 concentration as used in the forcing simulation (b) , the resulting change in total land C storage (c) , and the changes in the two main land compartments vegetation (d) and soil (e). CN-FLX and CP-FLX are the new simulations with flexible plant stoichiometry.

Figure 2. The global averages of the C to nutrient ratios on a molar basis for the two vegetation compartments in JSBACH. Shown are the results from simulation with rigid stoichiometry (CP and CN) as well as results from simulations with flexible stoichiometry (CP-FLX and CN-FLX).

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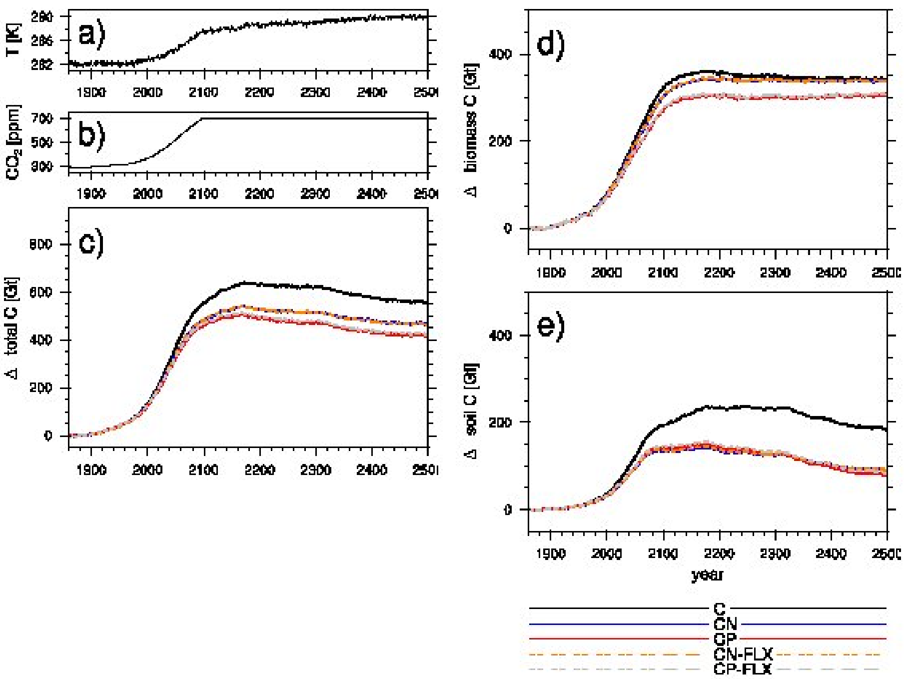

Fig. 1.

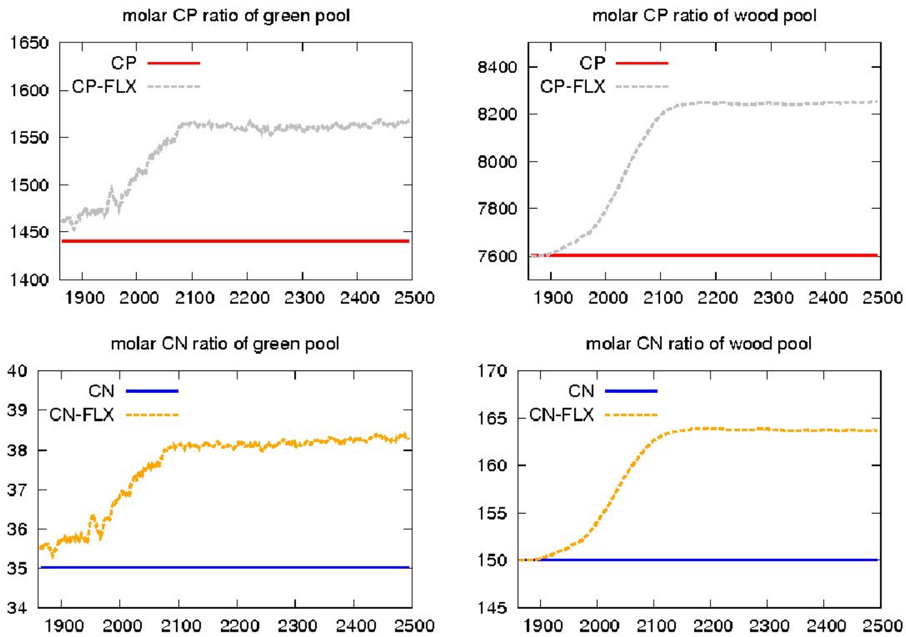
molar CP ratio of green pool
CP
CP-FLX
molar CP ratio of wood pool
CP
CP-FLX
molar CN ratio of green pool
CN
CN-FLX
molar CN ratio of wood pool
CN
CN-FLX

Fig. 2.