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# Coupled nitrogen - carbon cycle simulations for the 21st century with JSBACH-CN

B. R. Parida (1,2), C.H Reick (2), J Kattge (3), and M Claussen (2)

(1) Max Planck Institute for Meteorology, The Land in the Earth System, Hamburg, Germany (bikash.parida@zmaw.de), (2) Max Planck Institute for Meteorology, Hamburg, Germany (christian.reick@zmaw.de; martin.claussen@zmaw.de, (3) Max Planck Institute for Biogeochemistry, Jena, Germany (jkattge@bgc-jena.mpg.de )

Abstract: Nitrogen availability potentially limits carbon assimilation in most terrestrial ecosystems. So arguably, many coupled carbon cycle-climate models without nitrogen cycle significantly overestimate carbon sequestration and its future trend under a changing climate. Sokolov et al. (2008) pointed out that carbon-nitrogen interactions might significantly reduce net terrestrial carbon uptake and change the sign of the carbon cycle-climate feedback during the 21st century. The aim of this study is to investigate, by simulations, the interactions between global carbon and nitrogen cycles in a changing climate. We incorporated the nitrogen cycle in the process-based carbon cycle model JSBACH. In the coupled model, JSBACH-CN, nitrogen fluxes are computed according to a fixed CN-stoichiometry. Potential NPP in the CN scheme is reduced by the so called N limitation factor that is determined from N availability.

We present results from simulations with JSBACH-CN of the coupled carbon and nitrogen cycles for the 21st century. Simulations show that CN coupling is likely to have a fundamental impact on land carbon uptake. Land carbon sensitivity to increasing atmospheric CO2 concentration is lowering during the 21st century, and projected land carbon uptake is reduced by a factor of 2 by 2100 (c.a 3.7 by Thornton et al; 2007). By coupling nitrogen cycle explicitly in the model, reduction in land carbon uptake in the terrestrial biosphere would alter the magnitude of the positive climate carbon cycle feedbacks for the 21st century by increasing CO2 concentration in the atmosphere.

Luo et al. (2004) proposed that elevated CO2 enhances plant N uptake so that concentration of N in soils is reduced, causing a progressive nitrogen limitation (PNL). The simulated plant N annual demand shows an increase over time with increasing CO2. The simulated total soil mineral N availability decreases until 2050 (Like PNL); however thereafter it increases (Not PNL) due to warming. The PNL hypothesis after 2050 suggest that more N availability due to induced warming may change the magnitude of the climate carbon cycle positive feedbacks as predicted by the C4MIP experiments.