Geophysical Research Abstracts,
Vol. 11, EGU2009-3758, 2009
EGU General Assembly 2009

A coupled terrestrial nitrogen - carbon cycle model for JSBACH

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Nitrogen availability potentially limits the carbon assimilation in most terrestrial ecosystems (Chapin et al., 2002). To date, many coupled carbon cycle-climate models without nitrogen cycle significantly overestimate carbon sequestration and its future trend under a changing climate. Hungate et al. (2003) and 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 twenty-first century.

The aim of this study is to investigate, by simulations, the interactions between global carbon and nitrogen cycles in a changing climate. To study C-N interactions, we incorporated the nitrogen cycle in the process-based carbon cycle model JSBACH*. The coupled model, JSBACH-CN, has three plant pools, two litter pools, and two soil pools. Nitrogen fluxes are computed according to a fixed CN-stoichiometry. Nitrogen enters the terrestrial biosphere through atmospheric deposition and biological fixation, and is mainly lost through leaching and gaseous fluxes (denitrification). Net primary production (NPP) in the CN scheme is constrained by the N limitation factor, which depends on soil mineral nitrogen availability (SMINN), soil microbial N demand (ND), mobile nitrogen retranslocation, and plant ND. The total ND is computed as the sum of plant and soil ND, which is further compared to SMINN. We present first results from simulations with JSBACH-CN of the coupled carbon and nitrogen cycles for the twenty-first century.

*JSBACH: Jena Scheme for Biosphere-Atmosphere Interaction in Hamburg