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## ***Interactive comment on “Implications of incorporating N cycling and N limitations on primary production in an individual-based dynamic vegetation model” by B. Smith et al.***

### **Anonymous Referee #1**

Received and published: 19 December 2013

Overall, this is a nicely done study on the addition of N cycling to the LPJ-GUESS gap dynamics vegetation model to assess the effects of N limitation on primary productivity responses to environmental changes. Most of my questions/issues with the paper are related to how N cycling processes are incorporated into the model: 1) To the authors' credit, they do a reasonably good job of addressing the N fixation algorithm in the Discussion section, but I have to agree that this is a weakness in the model. Tying biological N fixation to evapotranspiration rates may work fine at very broad and coarse geographical scales (largely because ET is related to moisture and temperature, which are two important controls on N fixation), however we know that this will not hold across landscapes, or even regions, where N fixation is a function of soil N and P, as well as

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species composition. I think this should be one of the very next enhancements to the model, but I do commend the authors for not ignoring this issue. I was also curious (as this wasn't clear in the paper), at what temporal scale in the model is N fixation tied to ET, i.e. is daily N fixation calculate from daily ET, or is this done at coarser temporal scales? 2) Just to clarify (page 5, lines 15-17), gross N mineralization is determined by the C:N ratio of a receiver pool, which I think means that carbon entering the receiver pool drives N mineralization. So, if C and N are being transferred from donor pools to a receiver pool, the amount of available C (and the prescribed C:N ratio of the receiver pool) determines the N to enter that pool. If the supply is greater than the demand, then N is mineralized. If demand is greater than supply, then N is immobilized, assuming mineral N is available. Maybe this can be clarified in the description. Also, what happens if N amount required to meet the C:N ratio is not present in the mineral N pool? 3) The plant N uptake algorithm assumes no luxury consumption of N – how reasonable is this assumption? 4) The assumption that plants retain half of the N in shed roots and leaves, and the conversion of sapwood to heartwood is extremely general. N resorption represents a large pool of N for plants, and this parameter could be much better constrained. One other model question that I had was with regard to C4 grasses. The model assumes that C4 grasses are constrained to areas with a coldest mean monthly temperature of 15°C. This seems to me to be grossly incorrect. There are locations, where C4 grasses are about half of the productivity, that have coldest mean monthly temperature less than 0°C. This could be a factor in some of the model misclassifications. Related to this, on page 17 (lines 4-9), the authors state that the mechanism for increased CO<sub>2</sub> fertilization effects with decreasing latitude (increasing temperatures) are due to suppression of photorespiration, however in C4 grasslands, photorespiration would already be minimal.

Minor corrections: 1) Page 2, line 14 – “Cramer’s” should be “the Cramer” 2) Page 4, line 26 – “effecting” should be “affecting” 3) Throughout document – “savannah” should be “savanna” 4) Page 21 – line 12 – “necessary” should be “necessarily” 5) Page 21 – lines 27-29 – remove the sentence

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Interactive comment on Biogeosciences Discuss., 10, 18613, 2013.

**BGD**

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