

Interactive comment on “Nitrogen feedbacks increase future terrestrial ecosystem carbon uptake in an individual-based dynamic vegetation model” by D. Wårlind et al.

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Question 1: Please check if a figure of accumulative vegetation woody, non-woody, soil, litter N sequestration (analog Fig A1) may help to better understand the results. Answer: Thanks, also, for the very positive views voiced on the paper. For your first suggestion regarding expanding figure A1 to include woody and non-woody vegetation, soil and litter N, we have tried but felt the Figure would get to “busy” and difficult to read. However, we have included those findings in the text of the revised manuscripts (see page 12): “In the C-N simulation, woody vegetation abundance is initially lower, and the increase over the 21st century in litter pool sizes with N dynamics is due to the slightly

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larger increase of woody vegetation C and lower initial litter pool sizes compared to the C-only version. Especially in the mid-high latitudes the increase in woody vegetation has large impact on the C sequestered. In response to the future projected changes in climate and CO₂, woody vegetation in these regions becomes sufficiently dense for the process of self-thinning to be more prominent in the growth dynamics of the ecosystem, leading to notably enhanced litter input. This increased litter input can be observed in figure A1 as the sudden increase in litter C accumulated around year 2030, which more than compensates for warming-induced respiratory C loss through decomposition.”

Question 2: Page 154: the abbreviation PNV is used only two times in the paper. Is it useful to use the abbreviation? It would be easier to use the name. Answer: The acronym PNV has been replaced with potential natural vegetation throughout the revised paper.

Question 3: Page 156: Does soil moisture have an impact on N availability? Answer: Soil moisture does affect the N availability in the soil through the decomposition response function (equation C6 in Smith et al. 2014) that regulates the speed of decomposition, hence mineralisation. A short statement about this has been added to the revised paper: “The rate of decomposition is affected by a temperature and moisture modifier and the size of the mineral N pool if immobilisation is the dominant process in the SOM system”

Question 4: Page 157: “The simulations were made with 30 replicate patches to be able to represent the regional vegetation.” Does this mean 30 replicate patches per grid element? Answer: 30 replicate patches are per modelled grid cell. Details have been added in the text of the manuscript: “The simulations were made with 30 replicate patches per modelled grid cell to be able to represent the regional vegetation”

Question 5: Page 160: I would guess, if C sequestration is limited by the availability of N, the stoichiometry of soil and of the different plant tissues determines C budgets, while the C residence time does not contribute much to explain C balances? Please re-

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consider. Answer: In the long-term, stoichiometry is more important, but for a transient period, during which forests are densifying due to increased productivity in a warmer, high-CO₂ climate, the longer residence time of assimilated C in trees, compared with grasses, is crucial in explaining the effects of N limitation. In the C-N simulation, in mid-latitude forest areas, a greater proportion of the increased NPP is allocated to fast turnover pools (leaves and roots) compared to the C-only simulation where more of the increase is stored for some time in tree stems (until forests approach their carrying capacity and mortality catches up with increased NPP). We have tried to express this more clearly in the revised text: "The influence of N dynamics is most pronounced in the mid-high latitude cool climates where it reduces the woody component of vegetation in favour of a higher proportion of herbs and grasses. In other words, forests are simulated as sparser, with a more developed understorey, in the C-N simulation. As a result, a larger proportion of the general increase in NPP seen in mid-latitude areas over the 20th century is allocated to fast-turnover biomass pools (leaves and roots) in the C-N simulation, lowering the average residence time of C in vegetation, and reducing the amount of C sequestered"

Question 6: Page 163: Citation (Vitousek and Howarth, 1991; Vitousek et al., 2010; Wang et al., 2010). You may add Goll et al. 2012. Answer: Goll et al. 2012 has been added as a citation to P limitation statement.

Question 7: Page 165: "in a future high-CO₂ world" probably "in a future warmer and high-CO₂ world". Answer: We have made correction.

Question 8: Figure 3 and 4: Please check if the captions fit to the figures? Answer: We are not entirely sure where exactly the reviewer stumbled in the captions, but revised these slightly for further clarity.

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