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Interactive comment on "Nitrogen leaching from natural ecosystems under global change: a modelling study" *by* Maarten C. Braakhekke et al.

Anonymous Referee #1

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Braakhekke et al., use an Earth System Model to constrain the drivers of N leaching from 1901 to 2006. The manuscript is well written, interesting and contributes to a better understanding of the control of N leaching. Please find below a few comments that should be addressed before publication.

1) Atmospheric N deposition: theory and forcing 1.1. I am not really familiar with atmospheric N deposition, but from reading the manuscript it seems like the authors refer to nitrous oxide deposition, since N deposition is the highest in the most populated/polluted areas. I think a line or two properly defining atmospheric N deposition and its control could help better understand the paper. 1.2. It is stated that the forcing for atmospheric N deposition is taken for years 1850-1860, whereas the other forcings (climate and CO2) are taken from year 1901. I guess there is not much difference between 1860 and 1901 for N deposition or at least much less than between 1901-2006,

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but a) where do estimates of N deposition for 1860 come from? And b) why would you take 1860 instead of 1901? 1.3. Following on these 2 comments, I would suggest to restructure a bit section 3.1.1. as follow: The authors could start by describing Figure 1 and explaining the origin/controls of N deposition (natural vs anthropogenic effects, then describe Figure 2 and differences for each biome.

2) Comparison with previous estimates (Section 3.1.3) Beusen estimates seem to be significantly higher than LPJ-GUESS in Equatorial regions and southern tropics. The sentence L.13-15 is very unclear to me. L. 4: "higher productivity in cold and dry regions at other latitudes." To me it seems more like in the "mid latitudes". East Australia and South Brazil/Argentina are not really cold-dry regions. I am not really convinced by this section 3.1.3. I understand the authors want to try and compare their estimates with previous studies, but here a very rough comparison is made without going really into the reasons for these differences.

3) Climate section Due to the different impacts of temperature and precipitation changes on terrestrial productivity and soil processes, this section is a bit more difficult to follow. I would suggest the authors try to use terms which indicate the direction of the change: e.g. warmer conditions increase N mineralization. . .

Minor comments: P2, L. 15: "with increasing N input, the capacity of ecosystems to retain N decreases.." that statement surprises me. I can understand that with increasing N input, leaching increases, but the capacity to retain N does not necessarily changes.

P4, L6. Add "be" between can and found. P6, L. 27, "we" P6, L.29: remove "to" between by and "the fraction"

Notation of "N leaching : N input ration", I don't; really like that notation as ":" also denotes a ratio. I would suggest to modify to "N leaching/N input" or "N leaching to N input ratio". P8, L. 20: add "is" after variability

Section 3.2.1, L. 18: N deposition and pCO2 increased but not climate, please modify.

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P11, L.15, year of citation for Cleveland et al., is missing

Figures: not sure that showing the 99% quantile is the best way to go as areas with very large changes do not come out. You could also use a nonlinear color scale. Figure 8 and 9: I find it a bit confusing that panel c does not go all the way to 90S. It would be better visually to have the latitudes of the 3 plots match: i.e. if c stops at 60S, then c does not have to be shown over the whole vertical plot and would stop at 60S in panels a and b).

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