We thank the reviewer for the helpful comments which have led to an improvement of the paper. Below our reply to the specific comments, set in red font color.

Braakhekke et al. present a model study quantifying the respective contributions of changes in nitrogen (N) deposition, climate and atmospheric CO2 concentration on changes in N leaching from natural ecosystems. They find that increasing N deposition is the major driver behind simulated changes in N leaching, with smaller contribution from climate change and increasing CO2. They further highlight the role of fire in shaping N losses. The conclusions drawn have a sound basis on the the results discussed here. Overall, the manuscript is well written and clearly structured.

However, I find that the discussion of gaseous losses in the manuscript is lacking. Leaching losses are often the major loss, but gaseous losses are not negligible and can regionally dominated total N losses (Houlton et al. 2015). Accordingly, the role of gaseous losses needs to be considered when the ratio of leaching:inputs is discussed.

The author state in the introduction that "N leaching, while sometimes reported in global modelling studies, does generally not receive specific attention [...]". Therefore, due to the lack of evaluation of simulated loss terms, the reliability of global models in respect to the loss terms has to be considered low. This is true for LPJ as previous studies did not evaluate the loss fluxes sufficiently (Smith et al 2014 Warling et al., 2014). Unfortunately, the study by Braakhekke et al. does not improve this situation although data sets exist to evaluate. For example, the simulated gaseous loss fraction can be compared to reconstructions from delta 15 N measurements and models by Houlton et al. (2015) and, more recently Goll et al. (2017). There are regional differences in the dominant loss pathway between this study (Figure 3) and the mentioned studies which should be discussed.

We have added a figure and discussion on comparison of the fraction of N lost by denitrification to two global observation-based datasets: Wang et al. (2017) and Goll et al. (2017) (Figure 10). However, these two datasets differ considerably, demonstrating the current uncertainty regarding denitrification rates, also for observation based estimates.

The role of fire in shaping N loss pathways on global is a novel aspect of this study. The analysis would benefit from information on how simulated fire emissions and the contribution of wildfires to N deposition (forcing) compare to each other. Such information is completely lacking in the manuscript.

We acquired the dataset of N emissions from biomass burning used to derive N deposition. A figure has been added to the supplemental information (Figure S11), and the discussion on the role of fire (section 4.1.4) has been expanded.

In the abstract is stated "Predicted global N leaching from natural lands rose from 13.6 Tg N yr-1 in 1901–1911 to 18.5 Tg N yr-1 in 1997–2006, accounting for land-use changes." (P1L25/26). Did the authors account for land-use change? The information in the manuscript is insufficient to tell to what extent land use (change) and for example associated nitrogen fertilization was accounted for.

Since our study concerns only natural ecosystems, we did not consider N fertilization. However, to determine global total N leaching from natural lands, changes in natural land cover over time (mainly reduction) need to be considered. We did this simply by multiplying the fluxes by the natural landcover fraction for each grid cell. The sentence in the abstract to which the reviewer referred has been modified as to make this more clear: "*Predicted global N leaching from natural lands rose from 13.6 Tg N yr^{-1} in 1901–1911 to 18.5 Tg N yr^{-1} in 1997–2006, accounting for reductions of natural land*cover".

Minor P2L14: reference missing

Reference added.

P4L27: what is the criteria applied to define when the equilibrium state is reached?

During the spinup no checking is done to test how close the model is to equilibrium state. However, for soil organic carbon a root-finding solver is used midway in the spinup, to bring SOC pools very close to equilibrium. Testing has shown that this is sufficient.

P5L12: how are the grass PFTs being more competitive than trees in the model?

The higher competitiveness of grasses is achieved through PFT-specific parametrization, most importantly (cf also Smith et al., 2014):

1) Grasses have a higher uptake capacity per unit root biomass
2) In case insufficient N is available for all PFT (cohorts) N is partitioned among individuals according to a "relative uptake strength", which is higher for grasses.

P11:13: BNF estimates were revised down since Cleveland et al. 1999. Please account for newer estimates here; for example see Vitousek et al. 2013 , Sullivan et al. 2014.

We thank the reviewer for this good advice. The discussion has been updated to include the suggested references.

P14L23: The authors state that N deposition is the dominant factor driving spatial differences in the leaching rate. This needs to shown, as this is not apparent. I rather would suspect differences in the hydrological cycle to dominate spatial leaching patterns.

Our statement was largely based on the results of the factorial experiment (Figures 11 & 12, in the new manuscript). Because of the reviewer's comment we determined spatial covariation based on a moving window approach. This showed that both variation in precipitation and N deposition determine spatial patterns of N leaching, hence our statement was overly reductive. We removed it from the discussion.

P14L26: how is the correction done. This should be stated in the method sections.

This is described in section 2.3. We added a reference to this section.

Figure 4: the ratios, denitrification:inputs and fire:inputs, would be interesting to see and to better understand the lack of non-linearity in the simulated leaching:input ratio (Figure 6)

The suggested graphs have been added to the supplemental information (Fig S9 & S10).

P14L30: the substantial underestimation of BNF in LPJ should lead to lower leaching rates. This should be discussed.

A sentence has been added to the paragraph.

Reference: Houlton, Benjamin Z., Alison R. Marklein, and Edith Bai. "Representation of nitrogen in climate change forecasts." Nature Climate Change 5.5 (2015): 398-401.

Goll, D. S., Winkler, A. J., Raddatz, T., Dong, N., Prentice, I. C., Ciais, P., and Brovkin, V.: Carbon-nitrogen interactions in idealized simulations with JSBACH (version 3.10), Geosci. Model Dev. Discuss., doi:10.5194/gmd-2016-304, in review, 2017