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**Geoscientific
Model Development
Discussions**

Interactive comment on "Carbon-nitrogen feedbacks in the UVic ESCM" *by* R. Wania et al.

Anonymous Referee #1

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General comments:

This manuscript describes in detail how nitrogen dynamics and carbon-nitrogen interactions are incorporated into an Earth System Model. This study further simulates terrestrial carbon and nitrogen pools and fluxes between 1800 and 2000 and compares their simulation results with that from other CN-coupled Earth System Models. The manuscript is well written and easy to follow. Considering the large uncertainty regarding the role of N dynamics in C-climate feedbacks from the available C-N models, we need more global climate-C-N model studies to assess the robustness of the model findings and possibly to narrow the uncertainty in the prediction of future feedbacks.

I have two major concerns with this study. First, the new part of this study is the introduction of N dynamics. However, the overall discussion in this manuscript is very carbon centric, i.e. the discussions on the role of N in affecting the carbon fluxes

and pools are very limited. It is not clear from the manuscript what the mechanisms are responsible for the difference between CN version and C version of the model. Second, denitrification, which is the largest output flux for terrestrial N cycle, is ignored in this study. The lack of representation of this process might lead to incorrect estimate of mineral N in soils, which in turn affects the credibility of the CN model here.

Specific comments:

Page 75, Eq 17 and 18: the unit for QT is ms-1, so a time conversion factor is needed in the second part of the equations

Page 76, line 3: the critical soil C/N ratio for immobilization is set as 13, any more evidence to support this (theoretically or experimentally), except for the fact that it is in the range used by other models?

Page 77, Eq 22: For the sake of consistency, why not calculate BNF using NPP for both steady state run and transient run?

Page 77, Eq. 23: I am not sure this linear relationship obtained from steady state can be applied in transient run.

Page 78, line 7: was the N deposition data linearly interpolated or interpolated based on the fossil fuel emissions?

Page 81, lines 4-7: GPP is comparable for C and CN versions of the model at steady state run on the global scale. How about at grid cell level? How different are the vegetation C and soil C from the two model versions at steady state (in terms of both distribution and global sum)?

Page 85, lines 17-21: Since N leaching in this study is actually including N loss from denitrification, the comparison here does not make sense to me.

Page 88, lines 4-10: more discussion is needed on the difference between UVic-CN and UVic-C results? What are the roles of N dynamics here? Is it possible that the

difference shown in Figure 7 is caused by the difference between CN model and C model at steady state?

Page 88, lines 22-25: this is counter-intuitive. How N dynamics leads to a faster humification rate? The common scenario is that N availability limits decomposition when the N demand of decomposer is larger than possible supply of mineral N.

Page 90, lines 8-11: again what are the mechanisms behind the difference between the two model versions?

Page 91, line23-25: what is causing the disappearance of tropical C sink in CN version of the model? N limitation or other mechanisms? It is generally agreed that tropical lowland forests are not N limited.

Page 92, line 10-11: what kind of N effect is referred to here? The limitation effect due to N availability or the enhanced effect on GPP/NPP effect due to increased N availability?

Page 95, line 5-10: The CN version of the model here is considered as an more accurate version of the model, how can we trust the model results if it has an unrealistic representation of NPP:GPP ratio?

Interactive comment on Geosci. Model Dev. Discuss., 5, 67, 2012.