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Interactive comment on “Comparative analysis of the influence of climate change and nitrogen deposition on carbon sequestration in forest ecosystems in European Russia: simulation modelling approach” by A. S. Komarov and V. N. Shanin

Anonymous Referee #2

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This MS is a valuable contribution on the analysis of the effects of global change to temperate and boreal forest ecosystems. It is focused on combined effects of N deposition and climate change on carbon balance of forest soils and vegetation and it demonstrate overall effect of N deposition on forest carbon balance at regional scale on three different areas in Russia.

The manuscript is well written and focused on important and timely topic. Model

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description is short with necessary references to earlier publications on the applied model. In addition, model characteristics having high importance to presented analysis (competition for nutrients) are described in more details. However, description of the simulation conditions is not sufficient for evaluation of the study and its results. For instance, initial conditions (soil, stand structure, tree species composition) and site type distribution in different regions is not clearly reported and citations are to reports that are far from easily available for international scientific community. Since simulations were done without management (assuming that stands are conserved as forest reserves), limitations in the generalization of the results should be discussed. Results of this study are, to large extend, in good agreement with earlier simulation studies on combined effects of N deposition and climate change (see e.g. one of the earliest papers on this topic Mäkipää et al. 1999 CanJForRes 29: 1490-1501). However, present study extend earlier analysis of N deposition and CC by providing simulations on different site conditions and by providing analysis on forest carbon sequestration potential on regional scale. Thus, the manuscript provides a new remarkable contribution on scientific knowledge. This new approach should be, however, more emphasized in the results and discussion chapters. In the current version, results and their interpretation are written in a way that could be outcome of the stand scale simulation.

Earlier studies have reported both positive and negative responses of soil carbon stock to changing climate. Here, effect of climate change is analyzed together with nitrogen deposition and observed increases in the soil carbon stock are in good agreement with stand scale simulations by Mäkipää et al (1999). However, both positive and negative responses to increased nitrogen supply have been reported (see e.g. Jonsson & Curtis 2001, Pussinen et al 2002, Prescott 1995, Knorr et al 2005). Thus, findings of this study gives further light to the ongoing discussion on effects of N deposition and CC to soil carbon and I strongly recommend authors to further compare and link their findings to earlier studies.

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Abstract

- line 8, do you mean stable climate, i.e. climate without annual variation? or have you simulated stand development in ambient climate?

- line 9, specify how many or which levels of nitrogen deposition were analyzed

Introduction

- first three lines are very generic without specific meaning; thus, can be deleted.

- lines 18-20, meaning of the second sentence is unclear. I mean that last part of it '...linked with nitrogen deposition from the atmosphere' is not meaningful here. Furthermore, some references to earlier and textbook type of publications would be fine, since finding that N is limiting factor is older than paper by Sutton et al. 2011.

- page 6831, line 4-5, repeating what is said elsewhere.

- page 6831, line 25, meaning of 'individual-based model' should be explained.

- objective should be more specific, e.g. is forest management accounted? Is mixed ecosystem? Moreover, do not include citations into objective chapter, since it should be understandable as such (do not require a reader to check other papers).

- In addition, a specified hypothesis should be included into objective chapter to help a reader to follow your study.

M&M

- major problem in understanding M&M is lack of information on distribution of the site conditions. You have very general information on regions in chapter 2.4. but more detailed information on distribution of site parameters is needed.

- page 6833, line 14, how forest types were adjusted?

- page 6833, line 19, destructors?? Do you mean decomposers?

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- page 6834, lines 16-23, more information on distribution of site conditions is necessary to understand the results and where they are relevant and can be generalized.

- page 6835. lines 10-14 are not too informative (and repeats what is said in next paragraph), can be deleted.

- how annual climatic variation was accounted or was it ignored?

- page 6835, lines 26-29, not needed.

Results - authors are using terms 'carbon balance' and 'total carbon balance', but it is unclear for a reader what they mean. Following the context they may mean either carbon stock or stock change over un-specified time period. Pls, clarify, and consider using other word. Use term carbon balance only for stock change for certain time period.

- paragraphs started with sentences 'As seen from...' , 'Figure 5 reveals...' , '...are shown in Fig. 4.' should be modified to sentences that tell what is a result (don't expect a reader to work for that).

Discussion - discussion chapter would be more interesting if started by major result of the present study.

- In general, it was unclear what was considered as a main results and how they compared to current scientific knowledge. Pls, emphasize main results and compare them to earlier findings (from boreal and temperate forests)

- page 6840, lines 15-19, this part is more like results.

- page 6840, line 22, do not expect that a reader knows what is reported by Högberg. Pls, tell in more details what he found and how that is relevant in comparison to the present study.

- how reported NPP, respiration and carbon stock changes compare to a range of reported values in the earlier publications from boreal and temperate forests.

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- are the findings on soil carbon stock changes in agreement in earlier publications?

References Johnson, D.W. & Curtis, P.S. 2001. Effects of forest management on soil C and N storage: meta analysis. *Forest Ecology and Management* 140: 227-238. Knorr, M, Frey, S, D., Curtis & P, S. 2005. Nitrogen additions and litter decomposition: A meta-analysis. *Ecology* 86: 3252-3257. Mäkipää, R., Karjalainen, T., Pussinen, A. & Kellomäki, S. 1999. Effects of climate change and nitrogen deposition on the carbon sequestration of a forest ecosystem in the boreal zone. *Canadian Journal of Forest Research*. 29: 1490-1501. Prescott, C.E. 1995. Does nitrogen availability control rates of litter decomposition in forests? *Plant Soil* 168-169: 83-88. Pussinen, A., Karjalainen, T., Mäkipää, R., Valsta, L. & Kellomäki, S. 2002. Forest carbon sequestration and harvests in Scots pine stand under different climate and nitrogen scenarios. *For. Ecol. Manage.* 158: 103-115.

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