

Dear Dr. Kato.

Please consider our revised manuscript and response to referee #1 for review. We thank both referees for taking the time to review our manuscript.

Best regards,

Mats Lindeskog

Response to referee #1.

General comments

I appreciate the added exercise of evaluation which certainly have taken some effort to integrate and is necessary in order to give the study some credibility. Nevertheless, based on the results of this exercise, I think that in particular the underestimation of wood volume development for quite some sites should be better discussed (Model sensitivity to environment? Importance of structural issues not considered? Wood density or stem form?). Also, I am a bit irritated that this underestimation doesn't lead to a corresponding underestimation at the regional scale. For the general picture it would thus be good to elaborate a bit on this point (Unluckily selected examples? Problems with the inventories? Importance of disturbances?).

Adding text to Discussion: "The lack of certain physiological processes in the model, e.g. hardening/dehardening (Bergh et al. 1998), could explain why productivities along the whole temperature gradient in European forests cannot be fully represented in the model. Model tuning that aims for correct mean values of e.g. biomass and carbon fluxes over large geographic areas compensates for an overestimation of productivity in northern Europe by lowering average productivity along the whole temperature gradient. This could partially explain e.g. why the productivity of some south German sites is underestimated, while average productivity for Germany as a whole is in line with inventory data. Additionally, the selected individual German Norway spruce and European beech sites in this study were generally of above average site quality, and are not fully representative of German forests, which includes forests of other tree species, especially Scots pine (*Pinus sylvestris*) and oak species (*Quercus robur*/*Quercus petraea*), on lower site-quality sites. This is likewise in line with the smaller gap between modelled and observed growing stock (ca. 20%, Fig. E3) seen at country level, compared to individual spruce and beech sites in Germany (Fig. 7a)."

Adding reference: Bergh, J., McMurtrie, R.E., and Linder, S.: Climatic factors controlling the productivity of Norway spruce: A model-based analysis, *For. Ecol. Manag.*, 110, 127-139, 1998.

I can follow the authors in their argumentation which defends the initialization with old-growth forests based on simulated natural vegetation. I had the impression that arguments and also disadvantages of the one or other possible choice are well balanced.

From a technical point – and acknowledging that a number of smaller errors have already been removed – I feel that in still some places, grammar and wording need to be elaborated in order to increase understandability. Apart from these relatively small issues, I am looking forward to an interesting publication representing a step forward in regional to global modelling.

Specific comments (some issues that caught my eye, not a complete list)

L123 (figure caption): What does 'Stands belonging to stand types with trees can only be reduced in size.' Stands can get smaller? Do you mean patch size? Please find a more indicative wording.

To avoid ambiguities, we changed the sentence to "During land-cover change events, stands belonging to forest stand types can only be reduced in size." This should be in line with the text at the right side of Figure 1 which states that both stand types and stands occupy a dynamic gridcell area fraction, the text on l. 126 "Transitions between different stand types may occur at any point in time" and the text on l. 127-129 "When a potentially forested stand type area expands, new stands are created, keeping the soil history from the previous stand type intact and allowing vegetation succession to proceed from bare ground (in most cases, but cf. 2.2.1)." and hopefully be concise and clear.

L127: ', to recreate land-use history or effect a future land use scenario'. I know what you mean but I think it is not clearly nor correctly written – and may be deleted without any harm.

Changed sentence to "... to take into account land-use history or future land use scenarios."

L157ff: awkward sentence, rephrase and possibly shorten.

The sentence was rephrased and shortened: "To achieve an age structure among patches within a stand, the semi-randomised age structure of PNV (see Section 2.1) may be conserved after the conversion to managed forest if the cloning functionality is used (Fig. B1)."

L161: could you clarify '... may be clear-cut successively at regular intervals'? at one plot 'clearcut' and 'successively' would exclude each other. Do you mean plot by plot or do you mean thinning?

Changed sentence to: "may be clear-cut successively, one by one, at regular intervals", hopefully making it clearer.

L331ff: The sentences are too long and partly confused. In addition, wording and punctuation seems to not be precise in places (e.g. setup was done according to specific observations for each place but probably not differently otherwise; wouldn't 'some regeneration' occur independent of the homogeneity of thinning – and isn't that contradicting the later sentence that thinning from below was carried out?). So please check and reword the whole paragraph.

Changed section; splitting sentences and improving wording in some places:

"Four data sets of European beech and Norway spruce monoculture stand time series (1-21 points in time) of standing volume and harvested volume were used in simulations to initialise species and age structure, assuming a landscape distribution of even-aged stands. The stands were located in central and southern Germany (GER-Bav, GER-C, GER-CS) and northern Slovenia (SLO, beech only) (Appendix D, Table D1). Model setup and input climate data were as described in 2.4. Three different harvest strategies were used: no harvest, detailed harvest from observations and automated thinning and clear-cutting (2.3.2). The setup of the detailed harvest for stands from the different data sets differed slightly, depending on the number of harvest data points. For the stands from the GER Bav, GER-C and SLO data sources (3-21 data points per stand), the harvest data (fraction of biomass) were used in the simulations at the reported timings. During the time period prior to the first harvest data point, mean harvest intensities from the harvest data were used, in the case of GER-Bav and GER-C converted to fit a 5-year

harvest interval, while in the case of SLO keeping the 10-year intervals used in the sampling. The GER-CS data contain only one harvest data point for the whole stand lifetime (100 years). In this case, harvests were performed at 5-year intervals during the whole simulation using the calibrated harvest intensity values required to obtain a cumulative harvest fraction equal to the reported harvest fraction for the whole 100-year period. Thinnings in the detailed harvest simulations were performed equally for the different cohorts to obtain some regeneration of saplings in old stands. The automated thinning and clear-cutting method used the parameter settings in Table A3 and thinnings from below started at a stand age of 10 years.”

With thinning from below, new saplings are usually removed, at least with a 5-year thinning interval (same as the establishment interval in the model). Some of the German and Slovenian stands are old enough to be experiencing some age-related mortality in the model, so we get slightly less of a biomass decline when thinning all cohorts equally. This is for the detailed harvest simulations and thus not contradicting the thinning from below in the automated thinning simulations, where the tree density-induced clearcut avoids most age-dependent mortality.

L354, 395, 465: ‘oblast’ is Russian, better use the expressions county or district here.

Changed to “region”

L383: I would appreciate when another expression than ‘killed trees’ could be found.

Changed from “killed trees in disturbance events” to: “trees killed in natural disturbance events”

L673: Countries have modelled thinning fractions? What does this mean?

Changed sentence: “However, it is obvious that modelled thinning intensities for countries in the Balkans, except Albania and Greece, are higher than the corresponding reported total harvest intensities.”