We would like to thank Dr. Pekka Lauri for the time spent on reviewing our paper and the valuable remarks which pointed out some important issues which will help to further improve the paper. Dr. Pekka Lauri's comments are in grey, and our responses are in black with proposed edits for the revised manuscript in italics.

**General comments:**

**p12L200-215: The expansion of timber plantation depends on the share of production that comes from plantations (η). This parameter is exogenous and extrapolated from Pöyry (1999). This means that the expansion of plantation is not endogenous in the model, but it is taken as given. According to figure A5, the model assumes that share plantation increases on average from 25% in 2000 to 62.5 % in 2100. This issue should be made clear already in the abstract because it has significant impact on the results. For example, if the share of plantations were endogenous in the model, then an increasing demand for roundwood would increase the share of plantations relative to natural forests in EUR region. But because the share is exogenous this does not happen, and EUR region is not able adapt higher demand by intensifying their forest management (Figure A6).**

Yes, you are right, this is an important point. We will make this limitation clear in the abstract and add a sentence that highlights the assumption regarding the η parameter. p1L4 will be changed as follows: (...) elsewhere. *Using exogenous extrapolation of historical roundwood production from plantations and timber demand, we prescribe expansion of forest plantations at the regional level*. As a (...)

**The outcome of the optimal rotation models depends much on interest rates and usually these models include sensitivity analysis relative to different interest rate. To avoid this complication, the rotation times could be solved by maximizing increment (f'=f(ac)/ac) instead of maximizing NPV (f'(ac)/f(ac)=r). This would also be more reasonable objective for the recursive dynamic model where all other choices are based on recursive optimization instead of intertemporal optimization.**

Thank you for this important comment. We will add this capability (and switch to this way of rotation length calculation) in the model to calculate rotation lengths via maximization of increment. This will also be reflected in the main text and associated equations and figures (eq. 1, fig. 3). The resulting changes to rotation lengths will also be shown in updated fig. 4.

**Add some discussion about the forest age-class dynamics and optimal rotation models in the introduction. Basically move some material from discussion to introduction. Including forest age-class dynamics in the large-scale land-use model is the main contribution of the study, but this issue is completely ignored in the introduction.**

We will move the segment discussing the forest age-class dynamics and rotation lengths from p1L370:382 to the introduction part.

**Specific comments:**

**p2L26: According to FAOSTAT global roundwood demand was 3969 Mm3 in 2019 and industrial roundwood 2024 Mm3. Global roundwood demand cannot be 1683 Mm3.**

We will replace this instance of *roundwood* with *industrial roundwood* in p2L26. As there are no new estimates of the share of industrial roundwood production coming from plantations, we assume that the trends observed by Jürgensen et al. 2014 still hold. We also updated the industrial roundwood production data now based on latest FAOSTAT numbers. We will reformulate p2L26 as: (...) *likely supply more than 33% (654 Mm3) of global industrial roundwood demand (1984 Mm3) in 2020 based on historical trends (Jürgensen et al., 2014).*

**p2L26 Add reference or explanation for 33% (560 Mm3) plantation supply -> Pöyry (1999) extrapolation (Figure A5). This it is not data but model outcome.**

We will add Jürgensen et al. 2014 as a reference for this sentence. In fig. A5, an additional sentence will be added to the caption with a new formulation as: *Contribution of timber harvest from natural forests and plantations to industrial roundwood and wood fuel production in the forestry scenario (1995-2100) based on extrapolations from Pöyry (1999)*.

New reference: Jürgensen, C., Kollert, W., & Lebedys, A. (2014). Assessment of industrial roundwood production from planted forests. *Planted Forests and Trees Working Papers (FAO) eng no. FP/48/E*.

**p2L38: Add more relevant references for high roundwood productivity of plantations relative to natural forests than FAO (2013), e.g. IPCC (2006). Also, add some explanation why roundwood productivity is higher in plantations than managed natural forests.**

We will add the following references for high roundwood productivity of plantations relative to natural forests:

a) IPCC 2006
b) Payn et al. 2015
c) Cubbage et al. 2007
d) Evans and Turnbull 2004

From a qualitative point of view, plantations have more control on breeding material, fertilization, management intensity etc. than managed natural forests and hence more control of quality and quantity. We will also add the following explanation for higher productivity in plantations than managed natural forests in p2L37: (..)imperative. P*lantation forests for timber production have potentially higher annual average increment per area than natural forests and managed natural forests (IPCC 2006, Payn et al. 2015, Cubbage et al. 2007, Evans et al. 2004) because they are managed more intensively (fertilizer, thinning) and rely on high quality seeds and seedlings for regeneration*. *Because of* their (...)

**p6L124, p6L132, p7L136: Equation should be f ’/ f=r.**

We will correct the formulation in eq. 1. The changes requested in general comments – no.2 will also be reflected in this proposed change to eq. 1:

$$f'_{ac} = \frac{f_{ac}}{ac}$$

**Rotation times for timber plantations in Figure 4 are “interesting”, but the question is how reasonable they are. For example, with 30-40 years rotation time in Russia and**

**Europe you get only pulpwood (sawlogs require 60-100 years rotation). Moreover, it is not clear why rotation times are longer in North-America than in Europe and Russia. Is this connected to interest rates or productivity? There is only a small difference in interest rates (Table A2) and there should not be large differences in biomass growth between these regions. Some discussion of this should be added and eventually an update to growth curves, interest rate data and add a minimum diameter constraint for sawlogs.**

This is a very important point. We noticed that not having enough heterogeneity in the parametrization of our growth function with underlying parameters from Braakhekke et al. 2019 resulted in relatively homogenous rotation lengths within MAgPIE regions. We will change our rotation length calculation to maximize increment as suggested in general comments no.2 – decoupling the calculation from dependence on interest rate. We will also add some additional explanations regarding the assumptions for growth curves. In MAgPIE we do not use or model the minimum diameter constraint for sawlogs. Biomass extraction from trees is calculated based on expected yield and area information for simplicity.

**Is rotation time for natural forests determined by the same rule than for timber plantations (equation 1). If yes, then add similar map (Figure 3) for natural forest rotation time. It would be interesting to see the regional difference between timber plantations and natural forests rotation times. If no, then add some justification why natural forest rotation time is chosen differently than in timber plantations. Basically explain also natural forest rotation lengths in chapter 2.3.**

Natural forests are not bounded by rotation length constraints. The model is free to choose which age-class in natural forests to harvest based on harvesting costs and associated trade-offs i.e., during each optimization step, while harvesting natural forests, a decision is made whether it would be cheaper to harvest from alternative sources i.e., plantations. MAgPIE's objective function is to minimize global production costs. We use a lower harvesting cost (per ha) for plantations than in natural forests. This implicitly provides a signal to the model to harvest forests with higher growing stock first. We will add an additional sentence in p12L221 for clarity: (...) and maturity *as natural forests are not bounded by rotational constraints*.

We will also rename section 2.3 to *Rotation lengths* instead.

**According to Figure A8 EUR region growing stock decreases close to zero in 2100, which implies that forest management is not sustainable in EUR region. Easy way to avoid this would be to add additional "sustainability" constraint on harvests (harvests ≤ α x increment where α=1 for normal forests, α> 1 for old forests and α < 1 for younger forests). Alternatively, increase the share of plantation in EUR region. Basically take account in extrapolation of η that demand increases in the future. Interesting is also opposite development of growing stock in CHA region. This seems to be connected to the higher share of roundwood production coming from plantation in CHA region (Figure A7). Why cannot EUR region do the same as CHA region and avoid the decrease in growing stock ?**

We will increase the share of production which can possibly come from plantations in EUR. We can also confirm (based on a new model run with proposed changes) that altering rotation length calculations by maximizing increment as proposed in general comments no.2 and increasing the share of production than can in principle come from plantations in EUR (0.54 in 1995 to 0.86 in 2100) will result in stable growing stock development over time in EUR.

Updated numbers will be shown in table A4 and updated results will be shown in fig. A5, fig. A7 and fig. A8 in the revised manuscript.