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Interactive comment on "Simulating sustained yield harvesting adaptive to future climate change" *by* Rasoul Yousefpour et al.

Rasoul Yousefpour et al.

rasoul.yousefpour@ife.uni-freiburg.de

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Anonymous Referee #2 Received and published: 23 February 201

Forests are one of Earth's most important resources and wood harvest is one of the main ways in which humans are managing and impacting forest ecosystems. This paper examines the question of how an alternative future wood harvest scenario, based on a "sustained yield" (SY) approach, and responsive to a changing environment, would differ from the standard demand-based wood harvest scenarios currently used by Integrated Assessment Models (IAMs). Under the sustained yield approach, an-

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nual wood harvest rates are “optimized” and are equal to the annual rate of re-growth, thus keeping forest stocks maintained at their current levels. In addition, unlike most IAM wood harvest scenarios, the SY approach in this paper uses regrowth rates that are responsive to changing climate and CO2 concentrations, thus potentially allowing higher wood harvest rates than the IAM wood harvest scenarios that are based on static environmental conditions. This work shows one way in which IAMs and ESMs could improve and strengthen their interactions. The paper describes the results of a set of simulations using the dynamic vegetation model JSBACH, forced with climate data from Earth System Model runs from three different Representative Concentration Pathways (and thus three different climate futures). The paper compares results from these JSBACH simulations using both the SY wood harvest scenario as well as the prescribed wood harvest scenarios from the IAMs.

This is an interesting thought experiment, and yet it is not really presented as such in this paper. In fact, one of my main criticisms with the paper is the way in which the work is framed and motivated. The SY approach is unrealistic and it is not clear why, or how, a society would want to pursue a wood harvest plan that involved harvesting more wood than demanded and doing so by harvesting every patch of forest by the exact amount it would regrow each year. It is only in the Discussion that the authors acknowledge that the SY scenario is not meant as a plausible estimate of future wood harvest, but rather as an estimate for the ecological potential for wood harvest. There is also not a lot of explanation given for why IAM demand-based wood harvest scenarios are inherently problematic (aside from not responding to changing environmental conditions). The motivation for using this particular SY approach appears to be a mix of exploring how changing environmental conditions could alter the amount of wood harvest, and also how additional wood harvest could act as a carbon mitigation method. However, the effect of changing environmental conditions on the amount of wood harvested is mixed with the effect of the additional wood harvest that is imposed by the SY approach (which attempts to harvest much more than the demand-based scenarios). In addition, the mitigation potential of the SY approach seems like a fairly inefficient

way to capture and store carbon from biomass. The authors also do not address negative impacts of the SY scenario such as the impact on biodiversity (even partial removal of forest would have a negative impact on habitat), or the impact on the overall forest health that could result from continued and widespread human management. Due to the SY approach involving changing forest biomass in response to changing environmental conditions, as well as additional wood harvest to meet the forest regrowth rates, it is difficult to tell how much of the increased wood harvest is coming from the additional forest growth due to changing climate and CO2 concentrations, and how much is coming from choosing to harvest more wood, and in more locations, than the IAM wood harvest scenarios. It would actually be quite interesting to look at this some more and I think the paper would benefit from an additional experiment that was devised to do this (as outlined below).

Response: We gratefully acknowledge the valuable evaluation of the reviewer, who finds the study "an interesting thought experiment", and the useful comments to improve the readability and quality of the manuscript. We revised the manuscript accordingly to all points made by the reviewer and, below, we outline the main specific improvements requested by reviewer #2:

I think the paper would be much improved if a couple of key changes were made: 1) A better framing and motivation for the paper in the Introduction, to make it clear that the SY approach is a thought experiment to examine how much sustainable future wood harvest is possible, and why demand-based wood harvest scenarios are not sufficient.

Key changes 1): Reviewer #2 correctly emphasizes that the motivation for accomplishing this simulation study is to realize the potential of SY in harvesting wood and the long-term effects of wood products on the global carbon cycle for mitigation CO2. We have now used the keyword "potential" in the Introduction and call the study a thought experiment as suggested by the reviewer to avoid misunderstandings. We outline in the discussion now the alternative approaches for the simulation of global forest resource management beyond SY. We discuss the shortcomings and the effects of applying

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harvesting rules like SY on the ecosystem services besides timber production.

2) In addition to the standard demand-based scenario, and the SY scenario, include a third wood harvest scenario that uses the prescribed demand-based wood harvest scenarios, but allows for forest regrowth rates to change due to changing environmental conditions, and thus allows for changes in the actual wood removed from forests. For example, this scenario could use the prescribed wood harvest area in each gridcell (instead of the wood harvest biomass), or it could use the ratio of prescribed wood harvest biomass to prescribed available forest biomass in each grid-cell. Either of these alternative wood harvest scenarios would retain most of the information from the prescribed demand-based scenario, but would allow the actual biomass harvested to change with changing environmental conditions. This could enable a simple quantification of the impacts of changing climate and CO2 concentrations on future wood harvest, and would separate that effect from the effect of harvesting much more wood under the SY scenario.

Key changes 2): The suggestion of reviewer 2 for a third harvest scenario is an interesting suggestion how to interpret harvest rates prescribed by IAMs in a way such that changing environmental conditions are considered to a certain degree. However, in our study we do not target to show how IAM harvest rates might be interpreted in such a way, but to make an assessment of potentials and to state that these potentials reach far beyond the rates prescribed by IAMs. Regarding the separation of the impact of changing climate and CO2 concentrations and the effect of harvesting regrowth we extended our discussion: We added another simulation to the supplementary material in which we simulate SY harvest under present-day climate. We now refer to this additional scenario in our discussion of the effects of changing climate and CO2 on the achieved harvest rates. We interpret the differences between this SY and SY under RCPS as the effects of changes in CO2 and climate. Additionally, we point out that the differences in harvest potential of the three RCP-SY simulations are solely determined by their different climate and CO2 forcings. Finally, we shortly reflect

upon the differences in harvest amount between the SY simulations and RCPs in the first year of the simulation, which highlight the differences of applying supply side based harvesting (SY) versus demand side harvest (as applied in IAMs) under current climate and CO2 conditions.

Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2017-531/bg-2017-531-AC2-supplement.pdf

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