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Interactive comment on "Effects of land management on large trees and carbon stocks" *by* P. E. Kauppi et al.

Anonymous Referee #2

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The paper is a very timely discussion of the importance of tree demography, specifically large trees, with respect to ecosystem carbon accounting and other ecosystem services. The primary thesis is that large trees play an outsize role in ecosystem carbon balance. The authors provide a very informative summary of the unique histories of forest management in two regions of Finland and three regions of the U.S. I believe that their ultimate conclusion is correct, i.e., that large trees in particular and forest demography in general should be taken into account in forest carbon accounting and management.

However, the paper would benefit from a better sense of quantification, even in terms of general proportions. Most of the questions raised below have been very briefly alluded to in the introduction. However, save for a brief mention of Pan et al. 2011, there is little

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information to give the reader even a qualitative sense of the quantitative importance of big trees. For example, Le Quéré et al. (2009) have attempted to partition the global carbon budget into its major component fluxes, including land use and historical land management over the past century. Given that forests are the dominant feature of the global ecosystem and land use carbon budget, a better sense of magnitude of the issues raised would significantly improve the paper and its important thesis. For example, ecosystem photosynthesis and respiration fluxes are quite large, with their difference being the net ecosystem budget, which by comparison is quite small. On an annual basis that net flux can be either positive or negative, but as indicated by the authors has shown a long term trend for carbon uptake. The authors appear to be attributing much of that uptake to land management, that is, the recovery of once razed forests. However, global ecosystem models also simulate an ecosystem uptake over the past 100 years, but without simulating the history of land management. In general, the models have partitioned that gain to enhanced forest growth due to rising CO2 concentrations (a large affect, given the magnitude of the photosynthesis flux), warmer temperatures (longer and more productive growing seasons) and increased precipitation at higher latitudes. Several of the models have also explored the issues of wildfire, indigenous fire ignition and widespread fire suppression from regional to global scales and their effects on ecosystem carbon budgets. Can the authors place their hypothesis into this larger context, even qualitatively, in order to get a better sense of just how critical the big trees are to carbon accounting?

Also, given the importance of forest demography, it is surprising that the authors do not provide a general sense of the relative longevity of the forests compared to the length of the management cycles. For example, the trees in the NW U.S. can live for centuries, even up to a millennium or more, yet the harvest cycles might be only 40 years. Thus, much of the NW forests have been maintained in a near perpetual cycle of rapidly growing young trees. This then also begs the question of the turnover time of the wood taken off of the forests and put into long-lived products, analogous to the long-lived nature of carbon stored in big trees. What, then, might be the relative magnitudes of these two different pools of long-lived carbon? How long does it take a 'recovering' forest to regain its maximum level of productivity relative to the harvest cycle and is there an upper limit to how much carbon a forest can store, as compared to the amount that it might ultimately produce on an annual basis under a more intense management plan? How do these demographic questions compare across the regions studied in this analysis? Finally, are the authors able to extrapolate these questions (and responses) across the globe, given the quite different land management histories?

Le Quéré, Corinne, et al. "Trends in the sources and sinks of carbon dioxide." Nature Geoscience 2.12 (2009): 831-836.

Interactive comment on Biogeosciences Discuss., 11, 2735, 2014.