

## ***Interactive comment on “Age structure and disturbance legacy of North American forests” by Y. Pan et al.***

**Anonymous Referee #2**

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Overall I found this to be an interesting discussion paper and a useful presentation of a fresh compilation of information on forest age for North American forest landscapes. The concept of a continental forest age map is very attractive and could prove valuable in a number of applications, particularly as presented here for the great majority of North America, including all of Canada and the lower 48 USA. Although I feel the authors over-state the potential utility of their product from a forest management perspective, they rightly point out the value of this map product in terrestrial C modelling and improving land constraints in atmospheric inversion modelling. The paper would be improved if the authors were more clear about the nature of their product, including its spatial resolution, quantification of its accuracy, uncertainties, errors, and key complicating issues that users of the product ought to be aware of before attempting to use the product as input to their models (such as advice on the handling of uneven-aged

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stands – which are not recognized as such in the product, but do form an important presence on the landscape in some regions). Error structures in this map, I suspect, are not consistent across the continent given differences in methodology and data between US and Canada, and between regions in Canada (CanFI is certainly non-uniform in the quality of information it provides). I would like to request that in their revisions the authors please include some discussion on this basket of issues so that users of the product that are familiar with one region are not misled into thinking that the issues they will encounter in other regions of the continent will be similar. It would also be fantastic if the authors could indicate how to obtain a copy of the product (unless the preferred means is to have interested parties simply contact the lead author directly).

Note to editors: I have approached this review from the perspective of my expertise, which is with Canadian forest inventory data and their application in forest C modelling.

Specific comments and concerns:

p.991 line 17 → decomposition of slash left on site following harvest is important, but not acknowledged. Post harvest NEP dynamics will depend on the predominant harvesting methods employed and on the standard or typical handling of slash or logging debris. In some jurisdictions, operators are required to pile and burn logging slash, which causes greater immediate C losses but lower subsequent Rh C losses.

p.992 → Section 3.1 – Although I agree in principle that this sort of decision support function could be provided using a detailed forest age map, I do not see reported in the manuscript that your map product provides spatial presentation of the data at appropriate scale for this type of management decision-making support. That said, the Age-NEP relationship approach you describe could be an excellent approach to take in forest estate planning, such as in models that take as input high resolution forest inventory (e.g., 1:10 000 scale vector mapping) and optimize for various combinations of goals using LP solvers, of which NEP or C stock maximization could be one goal. In sections 3.2 and 3.3 you describe a much more likely direct application of your map

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and a more immediate contribution of this product to terrestrial C cycle research.

p.996 line 10 → not only is the assignment of age an imprecise exercise under the most straight forward of circumstances, there are also large areas of tolerant hardwood and other forest ecosystem types that are managed under selection harvesting silvi-cultural systems or whose disturbance regimes are otherwise characterized by non-stand-replacing mortality-causing events. For these ecosystem types, there can be no meaningful assignment of a simple ordinal age. This is perhaps a more serious problem than you acknowledge here. What may be required is some discussion on the issue that stand age as estimated using time since disturbance as a proxy may not relate to tree age, particularly in some ecosystem types (and in very old stands generally). I agree that sensitivity of regional NEP estimates calculated using the map and age-NEP relationships may not be excessively high as a result of this issue, but I think it should be a good idea to warn users of the perils they may encounter if they ignore these complications, especially if they are wanting to use the map for purposes other than those described in this paper (as I suspect will be the case - creative users may find novel uses for your product once it is made available). Can you quantify the proportion of forest by region that is likely not adequately described using ordinal age (e.g., include a class for “uneven-aged”) and suggest possible ways that users may choose to make use of this information if it is only provided as metadata (i.e. each pixel has an ordinal age assigned, but metadata describe regionally what might be going on with respect to unevenaged forests that one does not see in the map product itself)?

p.997 Section A1.1 – You should point out to your readers that data in CanFI are referenced to a wide range of data collection dates. One might find in CanFI two forest inventory records that both indicate stand age 100, for example, but one stand was inventoried as age 100 in 1950 and the other in 1986. The fact that CanFI was compiled from many different source inventories was the cause of this problem – but it makes CanFI a very difficult product to work with when one is interested in time-dependent stand attributes, such as age.

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p.1018 Fig 5 – you show bi-modal age class distributions for all of Canada, and this is most strongly exhibited in Canada’s northern region. I find myself deeply suspicious of your findings for Canada’s north in particular. This is an area where monitoring has been inconsistent (even in the LFDB; Stocks et al. 2002) and productivity is so low that estimation of age from spectral characteristics is very poor, especially for mature stands. Is there any independent justification you can provide to support these findings? The age class structure you report suggests that there was near zero disturbance in forests N of 60 during the period 1930-1970 and almost no forest older than 120 years in the entire region. The former is unlikely and the latter is simply not the case. More likely we have a bias here driven by the fact that stands (predominantly low productivity black spruce) show virtually no change in optical properties beyond a certain age. To be fair, Canada has very poor data on these forests, so even with these issues, your product still has value – there is no better alternative at present. Utility of your product, however, will be enhanced by providing thorough documentation of known issues and uncertainties.

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