

## ***Interactive comment on “Forest stand age information improves an inverse North American carbon flux estimate” by F. Deng et al.***

**Anonymous Referee #3**

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General comments: The authors of this manuscript made a good attempt to reduce the uncertainties of atmospheric inversion of the CO<sub>2</sub> flux by integrating forest age information with atmospheric CO<sub>2</sub> observations. Using the NPP-based age factor to constrain the spatial patterns of CO<sub>2</sub> fluxes at the continental scale is rational and reasonable because of the connections between the productivity of forest ecosystems, carbon sequestration, and the CO<sub>2</sub> flux. By integrating spatially-explicit information on forest stand age with atmospheric CO<sub>2</sub> observations from the global observation network, the authors have convincingly proved that the forest age factor method was effective for reducing the uncertainties of atmospheric inversion of the CO<sub>2</sub> flux, resulting in improved the inversion estimates of the flux to some degree. This method should benefit the inversion research community and may promote similar research in this field for improving atmospheric inversion of the CO<sub>2</sub> flux.

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Datasets used in this manuscript consist of the forest age map for North America derived from forest inventory data, large fire polygons, remotely-sensed data, gridded NEE dataset for temperate North America over the period 2000–2006 extrapolated from the NEE measurements to large areas with MODIS, and observations of global atmospheric CO<sub>2</sub> concentration (The GLOBALVIEW-CO<sub>2</sub> data). They are robust, well developed, appropriately used and cited in the manuscript.

In sum, this work is considered timely and relevant to a current problem: the uncertainty in atmospheric inversion of the CO<sub>2</sub> flux, and fits the Journal BGD properly in content. The manuscript is well-written and organized, logical, easy to comprehend, containing all necessary background information. Previous work relevant to this research has been well cited. The results are clearly presented and well discussed.

Specific comments:

1. Page 4793, Eqn (5) and (6): It may help readers better understand the relationship between  $f_s$  and  $f(\text{age})$  if an explicit equation for  $f(\text{age})$  and  $f_s$  can be provided;
2. Page 4794, line 6~7: “because NEE variations with age are mostly determined by NPP variations with age”, reference is needed here;
3. Page 4800, line 11~14: A comparison between the most densely observed regions and sparsely observed regions for the forest age factor method could be more persuasive for the authors’ conclusion here;
4. Further discussion on what are spatial and temporal limitations of the forest age factor method may help readers understand how to improve and apply it to practice;

Technical corrections:

1. There are a few wording issues as follows: Page 4783, line 11~12 “despite ...”, not quite sure what the authors mean; Page 4783, words “apparent” and “balanced manner” are kind of vague, better replaced with more objective and explicit words;

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2. Page 4785, line 13 “. . .and the atmosphere”;
3. Page 4785, line 13~17 “These types . . .observations”, rewriting may be needed to make the sentence simple and clear;
4. Page 4788, line 26: “. . .the driving forces”;
5. Additional words should be added for Figure 1 to indicate what numbers and green dot circles stand for, respectively;
6. Explain briefly how to produce Figure 2 in the caption of Figure 2;
7. To match the legend of Figure 3: using “empty square” and “red solid square” instead of (1) for age as a constraint and (2) for age not as a constraint could be better from the point of consistence (similar needs for Figure 4);
8. A diagonal line in Figure 5 (b) is missing.

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