Biogeosciences Discussions

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Reply on RC2

Chen Yang et al.

Author comment on "Updated estimation of forest biomass carbon pools in China, 1977–2018" by Chen Yang et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-18-AC2, 2022

RC2

In context of climate change, comprehensively estimate of forest C stocks will be helpful for forest carbon sequestration, as well as achieving target for carbon neutrality in 2060 proposed by the Chinese government. There is a timely need for a greater global perspective in assessing carbon sequestration using datasets of eight inventory periods from 1977 to 2018. The authors highlight that the pronouncing increases in total biomass C pool and average biomass C density of Chinese forests were largely attributed to afforestation practices, forest age growth, and environmental changes. Overall, the manuscript is well written and its objectives adequately addressed in the discussion section. I do, however, also have some more detailed comments on the manuscript. My recommendation is minor revision with reassessment by the editor.

General comment:

The authors should bring out the novelty of the study. The authors should be clearer about the uniqueness of the study.

While the paper presents some useful results, does the paper present new product or new methodology compare with other related studies?

In the discussion part, a real discussion about the effects of environmental changes on total biomass C pool and average biomass C density of Chinese forests should be stated, and its relationship to other existing works. Implications (clear and striking messages) about this topic also should be required.

Response: Thanks for the suggestion of highlighting the novelty and uniqueness of the study. We have stated our response to the analogous comments of the reviewer #1. Here we'd like to address two points in this study. First, the methodological consistency over the period from 1977 to 2018 together with the comprehensive national inventory databases of forests in this study guaranteed the reliability of C uptake estimations; and second, when the contribution of reforestation/afforestation to carbon sequestration have

been well perceived, the incorporation of the latest two inventories, 2009–2013 and 2014–2018, into the preceding six inventories in this study revealed the significant and persistent carbon uptake by natural forests on national scale in China, where the soil and climate conditions varied greatly in different regions. Additionally, regarding the methods, we applied the continuous expansion factor method (BEF) in our estimation, which is considered to be the most suitable method for estimating regional forest biomass C pools (Fang et al., 1998; Fang &Wang, 2001; Teobaldelli et al. 2009; Guo et al., 2010). Because the BEF method estimates biomass as a function of timber volume and thus incorporates effects of forest age, forest density and forest site quality, it can accurately estimate forest biomass of all age classes (Lines 57–66).

This temporal sequence of the estimated carbon sequestration by natural and planted forests are helpful for better understanding the importance of the national-scale reforestation and afforestation practices in China and the offset effects of forests to the anthropogenic C emissions. We also discussed the effects of environmental changes on the C uptakes by forests, though no quantifying analysis was conducted on these effects due to the data limitation. We have added the discussion in the revised manuscript (Lines 259, 268-272, 277-284).

Reference:

Fang, J., Wang, G., Liu, G., and Xu, S.: Forest biomass of China: An estimate based on the biomass-volume relationship, Ecol. Appl., 8, 1084–1091, 10.2307/2640963, 1998.

Fang, J., and Wang, Z.: Forest biomass estimation at regional and global levels, with special reference to China's forest biomass, Ecol. Res., 16, 587–592, 10.1046/j.1440-1703.2001.00419.x, 2001.

Guo, Z., Fang, J., Pan, Y., and Birdsey, R.: Inventory-based estimates of forest biomass carbon stocks in China: A comparison of three methods, For. Ecol. Manage., 259, 1225–1231, 10.1016/j.foreco.2009.09.047, 2010.

Teobaldelli, M., Somogyi, Z., Migliavacca, M., and Usoltsev, V. A.: Generalized functions of biomass expansion factors for conifers and broadleaved by stand age, growing stock and site index, For. Ecol. Manage., 257, 1004–1013, 10.1016/j.foreco.2008.11.002, 2009.

Specific comments:

Line 27: China's and here and elsewhere (lines 43, 54.....).

Response: Thank you for catching that. We modified accordingly. Please see Lines 26, 43, 53, 191, 258, 260, 283, 306.

Line 28: Ecological

Response: Yes, we did (Line 27).

Line 31: using full name abbreviation for CO2.

Response: Yes, we did (Line 30).

Lines 46–48: Please revise these sentences. There are some reports in several articles.

Response: Yes, we did (Line 45).

Lines 56–63: the advantages and disadvantages of these three common methods should be described in this paragraph, especially for BEF methods you used in this study.

Response: The advantages and disadvantages of these three common methods have been described in this paragraph, please see Lines 55, 57–66.

Lines 142: add a space between 30 and years.

Response: Yes, we did (Line 167).

Lines 207: Table 1 shows a negative vale of C sink of , also Table 2 for nature forests, could you explain these results and give more detailed discussion.

Response: The forests of China, as a whole, were C sources (-2.9 Tg C/a) in 1994–1998. This is the result of forest area loss and most importantly damages of the natural forests at that period (Guo et al., 2013). The area of natural forest decreased from 1994 to 1998 (Table 2), which led to a slight decrease in the total biomass C pool. We have added discussion on this issue (Lines 222–226).

Reference: Guo, Z., Hu, H., Li, P., Li, N. and Fang, J.: Spatio-temporal changes in biomass carbon sinks in China's forests during 1977-2008, Sci. China-Life Sci., 43, 421–431, 2013.

Lines 228-236: A constant C conversion factor of 0.5 was used to convert biomass into C in this study may be an uncertainty, different C contents for tree species and components were reported by many studies.

Response: The C conversion factor is a key parameter to the estimation. It may vary greatly among tree types, ages and organs which have been reported in many studies. With 576 observations of tree ages, size (diameter at breast height and biomass) and C concentration, a global analysis has found that the constant C concentration factor, which represents the C concentration of stem, to all trees introduced a systematic error of -2.5%–5.9% for forest C pool calculation (Ma et al., 2020). In the revision, we added the study of Ma et al. (2020) to support the application of the constant C conversion (Lines 293–294).

Reference: Ma, S., Eziz, A., Tian, D., Yan, Z., Cai, Q., Jiang, M., Ji, C. and Fang, J.: Size- and age-dependent increases in tree stem carbon concentration: implications for forest carbon stock estimations, J. Plant Ecol., 13, 233-240, 2020.