

## ***Interactive comment on “Changes in carbon stocks of *Fagus* forest ecosystems along an altitudinal gradient on Mt. Fanjingshan in Southwest China” by Qiong Cai et al.***

### **Anonymous Referee #1**

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Review MS No.: bg-2018-242 "Changes in carbon stocks of *Fagus* forest ecosystems along an altitudinal gradient on Mt. Fanjingshan in Southwest China", Qiong Cai et al. The manuscript presents a study estimating forest ecosystem C stocks and their change along an extended elevation transect dominated by *Fagus* species. C stock estimates are based on an extensive data collection allowing a complete assessment, i.e. including all relevant C pools. The aims of the study were to quantify C stocks and to identify drivers to explain the observed pattern of ecosystem C stocks along the transect. The authors also compared their estimated C stocks with *Fagus* forests in other continents based on published data.

C1

#### General comments

The paper is overall well written with the exception of some confused references to Tables and Figures. It is within the scope of BG addressing the question of drivers of forest ecosystem C stock changes. The C stocks estimates in living biomass, dead wood, litter and soil along the transect were based on thorough and comprehensive vegetation and soil sampling and analysis. To place the findings in the context of similar *Fagus* Ecosystem worldwide, a collection of published data was used. Beyond the estimation of C stocks along the transect, the paper presents no novel methods or insights in mechanisms to explain observed pattern, it can confirm existing knowledge. Given the large range of C storage in different C pools in the examined system and also in the systems used for comparison, the value of the comparison with other studies is limited. In the comparison it may have been interesting to focus and expand on differences and their causes, e.g. regarding the contribution of litter and dead wood. The roles of forest management and use intensity were only moderately addressed, particularly in the comparison with other forests. It may also have been valuable to place the results in the context of the National Forest Resource Inventory database, cf. Fang J, Chen A, Peng C, Zhao S, Ci L (2001) Changes in Forest Biomass Carbon Storage in China Between 1949 and 1998 *Science* 292:2320-2322 doi:10.1126/science.1058629.

#### Specific comments / technical corrections

Abstract, l.22: Rephrase; the wording is too general. The study presents reliable data on C storage as one among many ecosystem functions but not for understanding structure and function of Chinese beech forests.

l.29-30: The summary for policy-makers in IPCC 2013 is not an appropriate reference here. Technically, there are 5 pools since vegetation is separated into above- and below-ground parts. Consider revising the sentence and citing IPCC (2006) 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Agriculture, Forestry and Other Land Use. Available at: <http://www.ipcc->

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nggip.iges.or.jp/public/2006gl/vol4.html.

l.33: Delete 'even'.

l.45 and throughout the manuscript: altitudinal, altitude etc. Consider replacing with elevation, which is more appropriate term in this context; cf. McVicar T, Körner C (2013) On the use of elevation, altitude, and height in the ecological and climatological literature *Oecologia* 171:335-337 doi:10.1007/s00442-012-2416-7

l.50-51: grammar – 'there has been ... pattern' or 'there have been ... patterns'.

l.56: Consider revising: 'less C accumulation in total' since in relative terms younger stands tend to accumulate more carbon'. Also, biomass accumulation is likely to peak in a mature forest before declining again; cf. Pregitzer and Euskirchen 2004 cited in the manuscript.

l.64: Does 'unneglectable' exist, maybe revise to 'negligible' or 'insignificant'

l.90: Is 'consecutive' appropriate; consider 'continuous'.

l.149: It would have been interesting to give some indication on the variability of stand age to demonstrate how appropriate this estimate is for the primary and possibly uneven-aged forests. Or possibly a description of the presence/absence of different age cohorts.

l.160: The reference to Tab.2 is not clear in this context as it shows C cocks in the soil, which are not referred to in the preceding sentence, or in this chapter, which is about vegetation.

l.162, 166, Fig.1: R2 is presented which only tells how well the model is fitting the actual data. In addition it would be valuable to state whether the the coefficients are different from 0. This applies also to the results presented in sections 3.2 and 3.3.

l.181: Consider inserting 'total soil C storage'.

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l.194, 195, 198, 201: The information is not in Tab. 2, possibly you ar referring to Fig. 4?

l.204: Is worldwide really appropriate? The comparison of beech forests is based on European, Japanese and Chinese data. The American data are not mentioned in this section.

l. 208: Figure 3 was not previously introduced and is probably incorrectly cited here as Fig. 5 contains the relevant information.

l.222-223: The discussion could be extended to the effect of different management practices and intensities of use. Many beech forests in Europe have been heavily used in the past and show legacies but are now often under some form of protection; cf. Mund M, Schulze E-D (2006) Impacts of forest management on the carbon budget of European beech (*Fagus sylvatica*) forests *Allgem Forst- und Jagdzeitung* 177:47-62 and also Mund 2004 cited in the manuscript.

l.234-236: Consider moving this to the results section.

l.246-249: Please clarify this sentence 'At the same time...lower output'. The study did not measure decomposition rate. What is the meaning of output, C emissions? This was not measured. Possibly rephrase to indicate that this is an hypothesis as, for example, on l.250-251.

l.247-248: Please clarify this sentence 'Herein, .... Input of pland debris'. It is not clear how increased C storage can result in in increasd input of plant debris. Turnover of tree or shrub was not measured, and if it was the objective to discuss this aspect, a reference to literature such as Shaozhong Wang, Zhengquan Wang, Jiacun Gu 2017. Variation patterns of fine root biomass, production and turnover in Chinese forests. *Journal of Forestry Research*, 28: 1185-1194 may be appropriate.

l.253: Fig. 2 does not include information on soil.

l.264 & 182: The fact that the two secondary forests were disturbed by fire may explain

### C4

the comparatively high soil C as there may be fire-derived carbon.

l.265-267: The link between the first and second subclause is not clear. The reference Pregitzer and Euskirchen is not correct here, as they do not demonstrate a relationship between disturbance intensity and elevation.

l.267-268: 'therefore' is not appropriate as this it is an hypothesis.

l.278-285: A further limitation is the unceratinty related to the application of allometric equations to estimate tree biomass. Standard deviations are presented for soil C in Tab. 2.

l.297-298: It is not clear how the study contributes to the understanding of structure and function of beech forests in China. Rephrase to something like 'C storage and distribution among pools'.

Table 1: What is the explanation of the comparatively low age of 88 years of stand FJ4 relative to the other primary forests?

Table 2: Please indicate different meanings of the letters a and b, which are used to indicate significant differences.

Tab. 3: The data for American beech forest are missing.

Figure 3: It appears that this figure is never referred to in the text; the reference to fig 3 on l.208 appears to refer to Fig. 5.

Fig.4:Consider enlarging the figure or placing legend and coefficients differently. Table S2: What are the reasons and the effect of modifying the equations? How reasonable is it to use root:shoot ratios of trees for shrubs? This may no be appropriate, cf. Mooney HA (1972) The Carbon Balance of Plants Annual Review of Ecology and Systematics 3:315-346, and should be discussed as limitation and source of error.

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